APRIL 1983

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NORTHROP UNIVERSITY MAGAZINE

THE HUMAN IMPACT ON TECHNOLOGY

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Perhaps you have noticed . . .

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UNIVERSITY MAGAZINE

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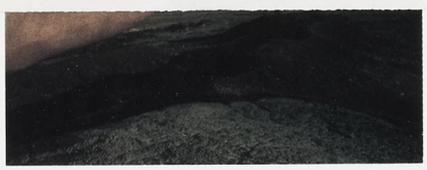

ON THE COVER:

'The Hand of Man'
photo by Jayme Odgers,
one of the artists
commissioned by the
L.A. Olympic Games Committee to
create an L.A. Olympics 1984 poster.

NUANCE aims for excellence

Dear NUANCE readers,

Over the past four years since NUANCE began, we have increased the in-depth articles, illustrations, and quality photographs.

We will continue to improve, but with your voluntary contribution, we could do it faster. We need the encouragement of your financial support, your ideas, and your letters.

If you are currently receving NUANCE, you will continue to do so. You do not have to subscribe. However,a yearly $10 contribution from even 10% of our readers, could help place NUANCE in the top 10% of college publications. In a way, this is a brave request. It is a measure of how much NUANCE means to each one of you on that long and special mailing list. Let's hear it from the readers !

Sincerely,
the NUANCE staff

P.S. We've even included a postage-paid envelope !

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April 1983 Vol. 4 No. 1

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editor's note

The Human Impact on Technology: 'Presumed Alive'

Something peculiar is definitely happening to the relationship of man and the machine. Until the space age, there was always a sharp distinction between what was human and what was machine. Tools were only extensions of the hand of man. Today, however, machines share some of the human capacity to perceive, think, and make decisions. Robots, automated systems, and new generation aircraft are no longer just extensions of human performance. They are designed as a fusion of human sense perceptions, thought processes, and skills, with machine capabilities. Not only are robots capable of taking over the blue collar labor force, but computers are now able to take on more flight and aircraft control. Suddenly, in the age of space flight, communication between man and the machine becomes vital to the survival of both. The relationship is now one of interdependence. As the space shuttle explores the first limits of manned spaceflight missions, the Pioneer spacecraft prepares to enter deep space for a first 'look' from the edge of the Solar System, and 4,805 'live' spacecraft, the scouts for future human directions, are now orbiting Earth, the sun, moon, and planets.

NEWSWEEK celebrated the new heroics of a human-machine age in a short eulogy to Viking Lander 1 placed emphatically at the end of the human obituaries:

> **PRESUMED DEAD: Viking Lander 1,** doughty three-legged spacecraft that touched down on Mars on July 20, 1976, and sent back thrilling pictures of bleak, beautiful Martian scenery; of electronic failure. NASA scientists had designed Viking 1 to function for at least three months; in fact, the plucky space pioneer lasted for 6 1/3 years, transmitting its final picture last November.
>
> NEWSWEEK/APRIL 25, 1983

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CASE: Citation Award

The judging of the entries in the "Best Articles of the Year Category" competition of the CASE Recognition Program has been completed and you are among the winners of a Citation award for "To Keep 'em Flying" which appeared in the Special Anniversary Issue of NUANCE, October 1982.

Congratulations on your achievement. You and your institution should be very proud of your success. The entries, 240 in all, were really exceptional this year.

Robert J. Armbruster
Director of University Relations
University of Maryland

Note: It is a special honor for NUANCE to receive national recognition for an article on the history and spirit of Northrop University. Special thanks to Tony Vai, Tex Hilley and Charlie Dietrich who helped communicate that award-winning spirit. —the editor.

Lear, Doolittle & Triple-I

The officers of Information International wish to congratulate you for the superb presentation of our company's digital scene simulation capabilities in the "Supercomputers Animate The Scene" article in the October 1982 issue of NUANCE Magazine.

Other magazines such as BUSINESS SCREEN, DISCOVER, and MILLIMETER have published articles on the same subject, and all of them have been weak stories that just scratched the surface.

Yours was thoroughly comprehensive, completely accurate, and beautiful to see. We consider it the definitive article on the subject and hope we can arrange to buy some reprints.

Arnold Sorenson
INFORMATION INTERNATIONAL
Director, Corporate Communications

Super article — also artwork! Thank you. It was a great Christmas present.

Moya Lear
Reno, Nevada

The copies of NUANCE came just as I was finishing up the office chores so I'm taking one home. Will read your article with interest.

J.H. (Jim) Doolittle
Carmel, California

response

Readers Write

I have just finished reading your October 1982 magazine, my first exposure, and I find it fascinating!

Neal Kinney
Employment Manager
Cincinnati Bell Inc.

Thanks for NUANCE It's a gem of a magazine. I really enjoy it. The cover is spectacular. The printing is perfect. It is 40 pages of fun activities. Please keep me on your list.

Carl T. Herrman
Director of Communications
MITRE Corp.

When I received the October issue of NUANCE I wanted to write you and tell you what an excellent piece of work you are producing. Today NUANCE re-surfaced, and as I re-read it, I vowed to sit right down and write this letter.

You are doing an excellent job and it is certainly a class publication. Congratulations.

Bernie May, Director
Wycliff Bible Translators
Huntington Beach, Ca.

As a means of remaining informed about Northrop University we would like to be added to your mailing list for your NUANCE publication.

Should you have any back issues available we would be glad to have them for our library.

Hans Friedebach
President,
United States Aeronautical Museum Society

The article on the light sculptures in the April/May 1982 issue is fascinating and a note in the same issue on the use of English as the international aviation language answers a questions I've had for years.

Stephen Yenser
Professor of English
UCLA

A Flying Stealth?

Thank you very much for sending me the Spring and Winter 1981 issues of your fine magazine which featured articles on the "Flying Wing". It is indeed a noble though tragic human tale especially in the light of some of the proposed ideas for a "Stealth" aircraft (which, ironically may be built by a much stronger and mightier Northrop Corporation!!)

William K. Krutz
Santa Maria, Ca.

Computer Animation

Through the kindness of Moya Lear, I've received your splendid October 1982 Anniversary issue.

If I don't impose would you send me a copy? I would like to offer it as a special gift to the Art Department of IBM located in Rochester, Minnesota. The manager of that IBM Section is an artist who has seen many beautiful things but NEVER has he seen such splendor — like your cover and page 19 with the fantastic pyramid of your supercomputers article.

Lisa Steinman, R.N.
N.Y., N.Y.

I found the article on computer art/animation ("Supercomputers Animate the Scene", October, 1982) extremely interesting and the overall quality of the magazine excellent. Presently I am a mechanical engineering major at the University of Vermont, but would like to enter the computer animation field. If NUANCE could send me the address of Information International Inc., Abel and Associates, Digital Effects, and Magi-SynthaVision, I would greatly appreciate this opening of a new door.

David Crist
University of Vermont

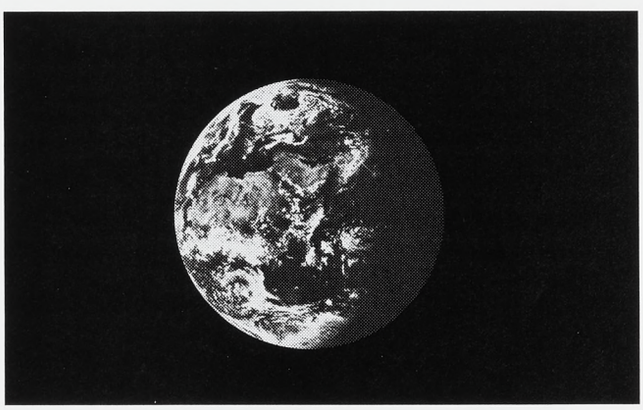
Information International, Inc.
5933 Slauson Ave.
Culver City, CA 90230

No Handicap Here

The October 1982 issue of NUANCE contained an interesting article "Door to Independence A New Kind of Education for the Handicapped". I believe the article was particularly insightful.

As an educator I am interested in being included on your regular mailing list. I would like to continue to be up-to-date about the work of Northrop University.

Harold Sunderland
Curriculum Consultant
Sonoma County Office of Education



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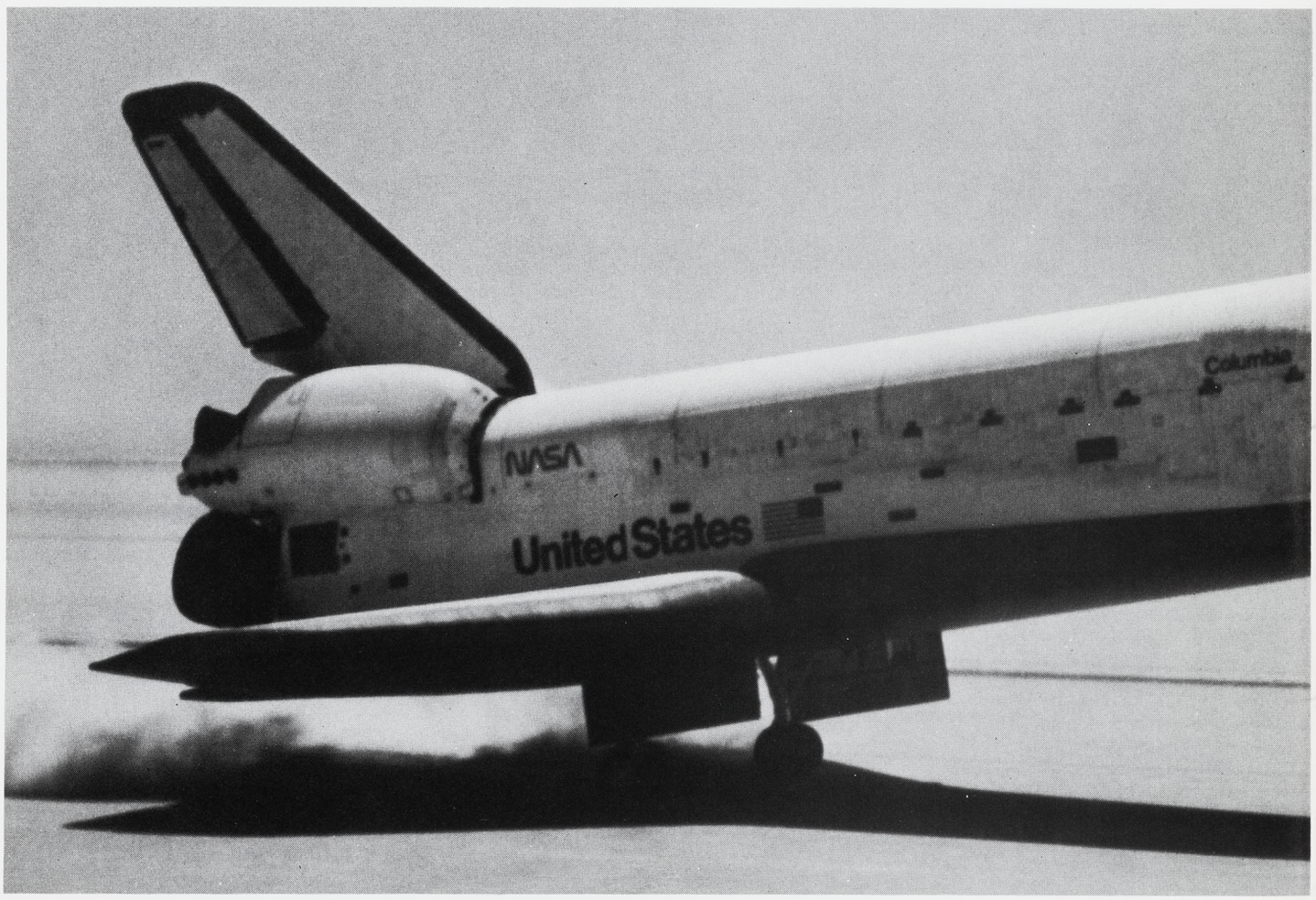

The Space Shuttle orbiter and main engines.

Valves for the largest gas transmission project in North America.

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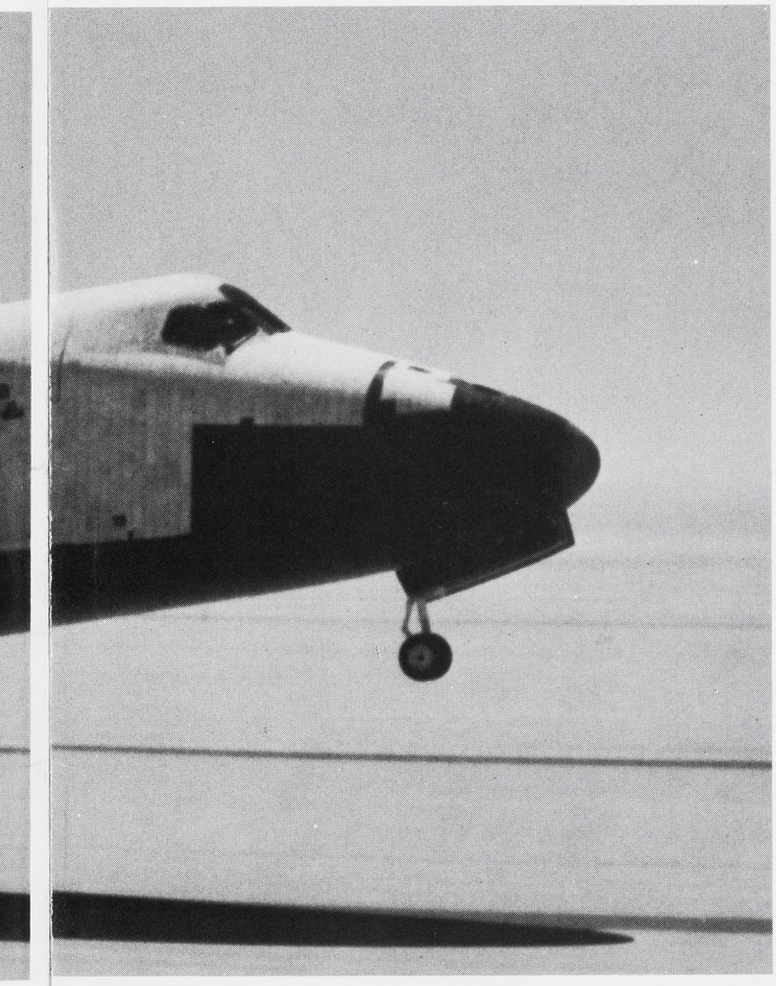

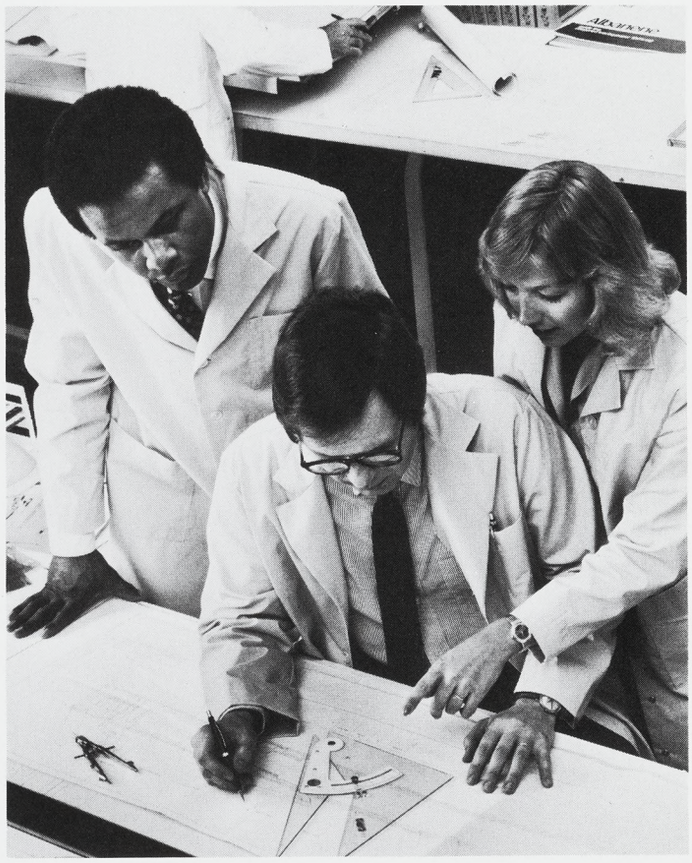

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Illustration by Roxanne Skene

THE FUTURE COCKPIT

MILITARY ADVANCES IN FIGHTER AVIONICS

James W. Wasson

New electronics and computer technology have revolutionized cockpit design as well as aircraft electronics. Applications of the integrated circuit and the microprocessor have transformed conventional analog communication, navigation, radar, and flight control systems through the use of digital data processing and mass storage techniques. The new avionic systems, monitored on cathode-ray tube (CRT) dislays, are smaller in size and weight, require less space, less power, and less maintenance than the conventional analog systems, while they have greatly increased the information flexibility and display capabilities of flight systems in the cockpit.

Modern military fighter aircraft, such as the F-15, F-16, F-18 and F-20 use high-speed, digital computers that form a distributed data processing network. Within this network, the various avionic subsystems communicate with the central computer via messages sent to a multiplex digital data bus forming the avionic system's architecture. The multiplex bus consists of a single two-conductor cable which replaces thousands of wire segments used in the analog circuitry and carries high speed pulses to and from the various processors in the system at a rate of one million bits per second. Next generation fighter aircraft will be carrying messages at 100 times that rate on a fiber optic cable.

In place of electromechanical displays, the cathode-ray tube (CRT) displays, similar to television screens, present the pilot with navigational, flight management, and weapon delivery information. The most vital information can be projected on a transparent screen mounted at eye level above the instrument panel which allows the pilot to see the symbols and information while still looking through the windscreen.

Military aircraft of the future will require even greater flight system integration made possible by advances in microchip technology. The fighter pilot will require even more cockpit automation because of the stringent, real-time mission requirements during attack operations. The modern fighter/attack aircraft already incorporates an advanced avionic system architecture designed for a sophisticated weapon delivery operation. In addition, multi-function CRT displays in the cockpit provide a multitude of useful information for the pilot to carry out a successful mission as a crew of one.

However, this increased sophistication can impose an additional task load on an already heavily burdened pilot if he can not quickly identify, assimilate and respond to the information presented in time to secure his survival. For this reason, the new discipline of human factors engineering evaluates crew performance and pilot vehicle interaction to determine the degree and design of crew station automation required to reduce pilot workload and task complexity.

For example, the crew station of the U.S. Navy strike fighter aircraft, the F-18 'Hornet', represents an advanced

Illustration by Roxanne Skene

application of integrated controls and computer-controlled CRT displays. Besides the heat-up display (HUD) on the glareshield, the instrument panel provides three CRT indicators with twenty pushbuttons located around the periphery of each display.

One pushbutton on each display changes the display format and the legends on the other nineteen switches to select submodes for that particular display. In addition, a data entry panel is used to control the communication and navigation functions. With this increased capability of information display, monitoring and control, the pilot has his hands full not only flying the aircraft, but operating the various onboard computers for the desired displays. As an interim solution, the F-18 has incorporated remote switches located on the control stick and throttle. This reduces the need for the pilot to remove his hands from the stick and throttle during combat manuevers. Other solutions to increase the pilot's interactive capability with these computerized displays include the application of voice interactive controls, the introduction of solution-oriented displays designed to present a range of pertinent information immediately accessible to the pilot, and moving map displays which present real-time computer-generated terrain, weather and navigational maps on a single display screen for a radius of up to one hundred miles.

VOICE INTERACTION

Voice command recognition and response allows the pilot optimum utilization and control of the information presented by providing what might be called an "electronic copilot." This computerized system recognizes and responds to the pilot's voice commands by matching his spoken words against previously stored voice templates. When it finds the proper match, the system outputs a signal to the appropriate switch function and may even respond verbally to acknowledge the pilot's command with a synthesized voice output. Voice control is especially advantageous during various high-G tactical manuevers where the pilot is restricted to a head-up configuration.

New information displays and pushbutton controls in the F-18

HIGHWAY IN THE SKY

Solution-oriented displays combine data from several related instruments such as weather, navigation, and flight control to provide a computer-generated image of the desired flight path on a single display screen. With the "highway in the sky", the pilot flys a simulated flight path projected on the head-up display or even on the pilot's helmet visor. With this type of display, the pilot can monitor the altitude, attitudes, and heading by simply following the "road" projected in front of him. Airspeed can be monitored by placing a simulated moving object ahead of the road so that he simply follows the animated "traffic", much like driving on the freeway.

MOVING MAP DISPLAYS

One of the most innovative concepts in the cockpit is the moving map display which presents a color digital terrain map of the topology the aircraft is approaching. This is especially useful while flying low-altitude during zero visibility. The implementation of the real-time color digital terrain maps requires mass memory storage and very high-speed computation which will be possible with further advances in very high speed integrated circuit (VHSIC) technology.

Other advanced cockpit control/displays, such as touch panels or transparent membrane switches overlaid on flat-panel color video displays, are currently being developed to allow effective pilot-machine interaction. With touch panels, the pilot can scribe his selected course with his finger directly on the moving map display and then simply fly the aircraft along the projected "highway in the sky."

In order to provide the vast amounts of data required for these advanced systems, fiber optics are being developed as a medium to transmit data on multiplex buses instead of the familiar twisted shielded wire pair. One concept, known as the wavelength division multiplexing (WDM), is under study by the defense industry. This system communicates commands to the various processors in the network through light pulses of a certain wavelength (color). For example, a red light pulse train may be filtered into a command signal only by the

processor which is sensitive to that color of light. The wavelength division multiplexing (WDM) method greatly reduces the bus traffic overhead by eliminating the processor address code required in the first word of every message sent over conventional multiplex buses.

FAULT TOLERANCE

The complexity of the new avionics sytems could have resulted in higher maintenance costs if the avionics manufacturers had not designed the built-in-test (BIT) circuits to monitor the operation and performance of the avionic systems and to locate the cause of failures. With BIT, the faulty component can be located quickly and easily by simply monitoring the malfunction display in the cockpit. Fault tolerance is one step beyond BIT. It allows the various processors to not only isolate the fault, but restore the failed function by automatically substituting other hardware or software, or a combination of both.

THE 1990's

Tomorrow's cockpit will increase the critical decision-making time available to the pilot without increasing the human workload. With the advanced warning and information available in the new systems, the pilot is able to plan ahead of the aircraft. This is especially crucial to fighter aircraft operation where a 20 second warning can be a critical advantage. The pilot will be able to solve the future problems while the computer handles the real time operations. nu

James W. Wasson graduated from Northrop University with a Bachelor of Science in Engineering Technology. He presently works in research and development as a Senior Technical Specialist in Advanced Avionics Systems Design at Northrop Aircraft, Hawthorne, California.

AVIONICS TRAINING

Ever since the first radio was used in an aircraft, the field of Avionics has been one of the most rapidly growing segments of the Aviation industry. Responding to the heightened need for persons trained in Avionics, Northrop University's Institute of Technology has expanded its Avionics Technology Program . . . the result of two years of extensive research, careful planning and coordination with industry leaders. 600 contact hours have been added, bringing to total electronics/avionics training time to 1,440 contact hours over a period of 48 weeks.

This means more time for electronic fundamentals, including circuit theory and application; digital circuitry, microprocessors and microcomputers. More time to receive theory of operation of typical avionics equipment. And, more time to learn about the latest maintenance practices through actual "hands-on" experience with typical equipment installations. In short, the completion of Northrop University's highly specialized Avionics training will better prepare you for a more productive career.

The program may be entered at various levels, depending on your previous electronics background. Night courses are also available giving you greater flexibility in scheduling your education. Students may also enroll in the 58 week Airframe and Powerplant program leading to the FAA Airframe Mechanic Certificate.

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northrop university

THE GLASS COCKPIT

PHILIP STRUYK

Lockheed-California
Future Flight Station
1985 technology

In search of a new human-machine capacity

The aviation industry is a frontier of new human-machine coordination. The airplane in flight represents a unique integration of human skills and machine capacity designed to maximize aircraft performance, compensate for human limitations and enhance human capabilities.

The challenge in designing new aircraft controls and displays is to increase the capacity of the machine without increasing the workload of the crew. Aircraft manufacturers, the Air Line Pilots' Association, the FAA, NASA, and the U.S. Air Force are all currently testing revolutionary cockpit designs and computer systems for integration in next generation aircraft. The concern is not how to increase the extent of automation and the amount of information, but how to integrate the crew into the flight and aircraft systems automation for optimum human-machine performance in flight.

They call it 'the glass cockpit,' the advanced flight deck, the crew's station, and now even the pilot's desk. With advances in the use of microprocessors, glass panel displays, and improved satellite data links, the aircraft of the future will be able to control the fourth dimension of flight, the dimension of time. Today's flight control systems in aircraft like the Boeing 757/767, Lockheed's Tri-Star, the Airbus 310, and the DC-9, already control the first three dimensions of navigation: altitude, velocity, and location. The future integration of flight control systems, such as the 4-D navigation system currently being developed by Lockheed-California, with modernized weather collection and improved air traffic control systems will allow the pilot to predict and control flight arrival time with an eight second accuracy.

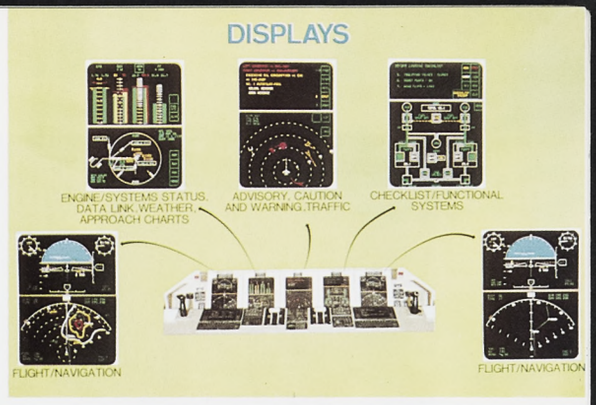
Greater on-board computer capacity provides an opportunity to relieve the crew of simple memory chores, certain routine data processing tasks, and even procedural decision making. The current challenges to flight station designers is to identify the appropriate tasks for automation and the appropriate level of automation for each task, as well as to determine the proper integration of the function with other aircraft and flight systems, including the crew.

Voice command, touch-sensitive panels, and alpha-numeric keyboards are part of the interfaces designed to keep the pilot in immediate touch with each flight and aircraft system. To avoid clutter and confusion, only priority information is displayed on large, color cathode ray tubes placed strategically on the windshield and across the instrument panel. In this highly automated cockpit, crucial new displays and controls allow the crew increased communication with all aircraft flight activities.

FROM EVOLUTION TO REVOLUTION IN THE COCKPIT

Until recently, cockpit design was a matter of modifying controls and displays as new equipment became available. The resulting flight stations appear as a collection of knobs, switches, and displays. Although it may be another decade before commercial aircraft totally revolutionize cockpit design and integrate flight and aircraft electronic systems into a new, large-scale interactive network, the trend is starting in a new generation of commercial airliners.

With 120 microprocessors in the aircraft electronics networks and eight CRT's in the cockpit, the B767 represents a radical change in cockpit systems design and operation. The integrated avionic systems on the B757/767 store flight plans, indicate flight progress, issue control steering,



CRT Displays
1983 technology

Philip Struyk teaches Avionics
at Northrop University
Institute of Technology

commands to the flight director and autopilot, and monitor the aircraft performance for optimum safety and fuel efficiency. The Boeing aircraft won special praise from the FAA Certification Review Team on CRT Displays for its MAP mode function on the Electronic Horizontal Situation Indicator which enhances pilot's awareness of the aircraft's attitude relative to the horizon, and for the new engine instruments and caution and alerting system EICAS display which presents a composite display of engine essential engine instruments and indicates the status and action priority to the pilot.

COCKPIT 2000 A.D.

On-going flight station design at Lockheed-Georgia is taking cockpit design and controls a step further. Working with both the Advanced Transport Operating Systems Program and the Man-Vehicle System Research Facility Project of NASA, Lockheed-Georgia is building a generic 1995 flight station to incorporate advanced technologies and automation. So far, according to George Sexton at Lockheed-Georgia's Advanced Flight Station Design, the preliminary soft mock-up of the flight simulator has been completed and the crew systems interfaces tested. In 1984, a full mission capacity simulator will be completed for full mission operating tests.

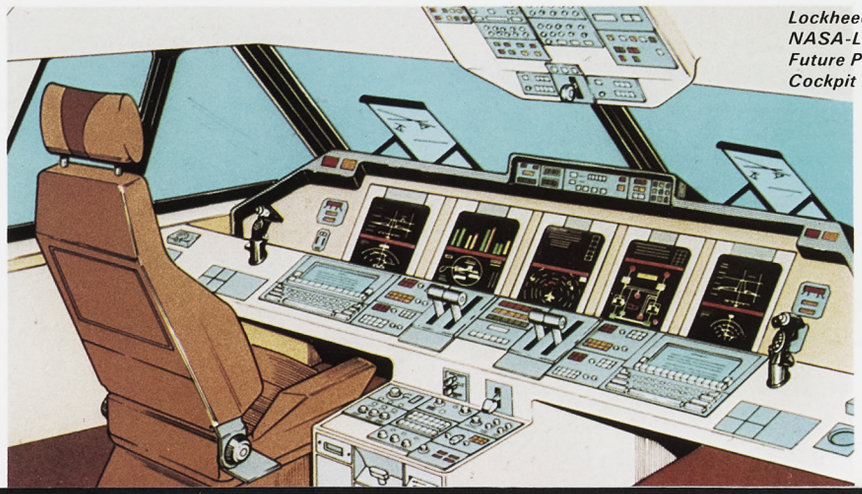
The Pilot's Desk Flight Station is a unique design resembling more of an operator's console, than today's cockpit. According to George Sexton at Lockheed, the desk-top design is possible because of the use of fly-by-wire and fly-by-light flight and thrust control systems, without mechanical redundancy, which eliminate the requirement for large columns, control wheels, or center sticks, and mechanial throttle levers. This, in turn, permits more efficient use of the instrument panel space presently occupied by those controls.

The simulators being developed as the Pilot's Desk by NASA and Lockheed, will use five vertically-oriented 13-inch diagonal, color, cathode ray tubes mounted side-by-side on the main instrument panel, as well as two monochromatic, flat-panel displays on the desk top. The center three displays and the two flat-panel displays have touch-sensitive panels over their face to provide the pilot control of the systems by a simple movement of his finger.

Other unique features of the design include: operational control by either pilot, in either seat; automatic loading of navigation and operational data into aircraft computers; performance management systems integrated with a four-dimensional navigation system and the automatic flight control system; a Mode S data link of traffic and weather information with a CRT display for each, integrated control of communications, navigation systems, and transponders; a hard-copy printer for pilot selectable information; and a voice command and response systems for announcing advisories, cautions and warnings, accessing call-up information, entering information into computers, and controlling a limited number of systems.

By 1995, the cockpit of the future should be ready to be manufactured and installed. nu

Airbus Industrie
A300
The Logical Flight Deck
1980 and 1990 technology



Lockheed-Georgia and
NASA-Langley Research
Future Pilot's Desk
Cockpit 2000 A.D.

Photography by Chauncey Bayes

Organic Pascal

The white marble block from Italy still stands in the driveway next to the Honda. The oil paints and brushes are lost in an upstairs closet. After twelve years as a sculptor and two decades as a painter, Howard Ganz discovered a more fertile medium in the computer.

Modeled on organic forms and processes in nature, his computer program ORGANISM, generates variations and makes random choices to produce organic shapes in two-dimensional designs. The new art form is as much a science as an art. At times, the artist must even become a mechanical engineer building new parts of the hardware and the new methods to color the printer's ribbons.

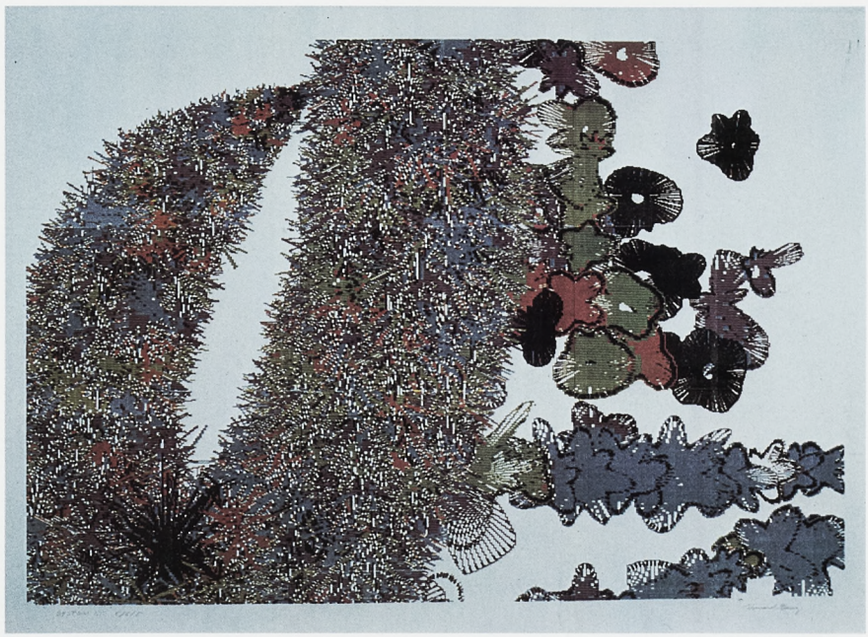
Using an Apple II computer and a Trilog Colorplot 100 Printer, Howard Ganz is now recognized as one of the first to take computer graphics into the realm of computer art. His first program was published in 1980 by Apple Computers as ARTIST DESIGNER in Special Delivery Software. His latest program, ORGANISM, written in Pascal, allows the artist to generate images and designs in continuous variations. As in nature, each pattern, each design, is distinct.

When Howard is not teaching painting, or art history, or drawing, and when he can find time away from his office as Chairman of the Art Department at Mira Costa College in Oceanside, he is improving his program, giving exhibits and lectures on the computer revolution in art, and working on a dream to interface his computer program with a manufacturing process to show the many variations possible in a simple chair, or table, or textile.

Howard Ganz believes that the highest degree of creativity is in the mental process of imaging the finished product. He sees the computer as the ideal tool to help artists visualize and explore the variations of shapes and designs. His goal is not to make duplicates, but to enrich the variety within the living environment.

A CREATIVE CHAOS IN COMPUTER ART

At an exhibit of his prints during Northrop University's Alumni Day, Howard Ganz explained his philosophy of computer art.



Nuance: What does the computer offer you as an artist?
Ganz: The real opportunity that the computer offers the artist is to show that art is conceptual. It is not what I do with my hands that makes me the artist. It is what I do with my mind. It is a tool that allows the artist to work with ideas for the first time.

The artist, who used to produce only one object at a time, now finds that his program can produce a countless variety of objects and images. The artists, who in the past were displaced by industrial production systems, will now be able to return to positions of leadership by performing the important work of creating successful models of reality to direct our production systems.

It is important that artists, or those with aesthetic sensitivity, do this work since they will leave a strong imprint on our environment. The schism which developed between the natural environment and our industrial environment can now be mended by computer-controlled production where products can be formed with the varitey and unity of natural systems.
Nuance: How would you describe your computer program?
Ganz: My program is called ORGANISM. When driving a printer, ORGANISM is a production system which responds to descriptions input by users and which outputs continuous variations of designs in two dimensions. ORGANISM is a thrust toward systems which can produce varied families of forms as do the systems of nature.
Nuance: What are the basic principles you use to model organic form?
Ganz: The first principle of organic form is randomness. This concept is at the base of all structures. The least constrained arrangement of objects is where they are all chosen at random, and in all arrangements the concept of randomness works hand in glove with that of constraint. Choices are constrained only to the degree necessary to achieve the desired form. Within the bounds of necessary constraints, choices are made at random.

Designing structures on a random background and allowing randomness to enter any domain to the limits of its constraints is to emulate the concept of entropy. One of the results in ORGANISM, as well as in nature, is that all objects exist in variations.

The second principle of organic form determines that the basic shape of form is round. The most complete, balanced and stable state of form is that of the greatest roundness.

Perfect roundness would be the greatest constraint. Perfect randomness would be the least constraint. Neither can exist in perfect states, as they are always interrelated.

Particular forms exist in many different shapes between roundness and randomness. Perhaps the most practical meaning of the concept, form is round, is that regardless of how irregular a particular object might be, its structure is measured and performed from its center.

That is the third principle of the system. When building structures out of objects, the most important relationships are those which relate centers to centers. Fitting edges to edges might also be of concern, but much less important than the relationships among centers.
Nuance: How much control do you keep over the design?
Ganz: I carefully define my process so that it will allow variations. If I want to make a design which is a centered design, I don't say, 'put it in the center.' I tell the computer to put it around the center. Then I decide how close to center it has to be to satisfy the design. If the need is not too great, then any place within very broad limits would work.

At some points, I may exert strong control, at other times I may be looser. In writing the programs, I always leave looseness to whatever limits the structures can take. But, as an artist, yes, I am standing there judging how much it can handle.
Nuance: What is the importance you see in variation?
Ganz: It think it is very detrimental to our environment to produce duplicates. I think duplicates produce a very poor environment. The original natural environment has all kinds of variations in it and I have tried to demonstrate that a production system can produce this kind of variety. The very soul of my work is to show that a production system can produce continuous variations and still be under control, still give the kinds of things needed. People have to stop asking for duplicates. There is

something wrong, as far as I am concerned, in a mentality that demands exact copies.

Nuance: What is the significance of the computer from an artist's point of view?

Ganz: The use of the computer is a much more important technological advancement than the printing press because of its ability to generate unique situations and variations of form. It does not merely reproduce and assemble. It integrates the variations into a totally new form.

Nuance: What are the major problems you solved in building your organic modeling system?

Ganz: The commercial computer industry hasn't been concerned with permanence in the final generated image. I had to run rag content paper through the printer and I had to get inks that were permanent and even ink my own ribbons.

Nuance: Is that as tedious as it sounds?

Ganz: Being an artist and into these kinds of messy things, I do it if I have to. After a lot of tedious hours I was able to ink the ribbons by hand. Then, my son, who is studying mechanical engineering, helped me design a set of rollers that would ink the ribbons. So, now its fairly easy to do.

Nuance: What is the next step you are working on to improve your system?

Ganz: There are two new cards that have come out of Apple in the last few months which will handle everything I am doing now in the computer itself. Right now, I have to put nine screens on the disk and I am only using 1/9th of that memory at one time. The new card will allow me to do all that in the main memory. That means, if I wanted to shift those screens to disk, I would actually go nine times the size of my prints. But I think I'm going to try four feet by six feet, which is four times the current size.

Eventually, I will be dealing with more than six colors and using much larger formats.

Nuance: What are the future developments for organic form in computer art?

Ganz: One of the most recent things I have realized is that the system is too large to ever see all of its possibilities. There needs to be some way to search the system to find what you want in the most fruitful way. It seems necessary to keep more careful records of the parameter choices made by the user so that you know what parts of the system you have tried. I used to keep records by hand but now I have a program which provides all the pertinent information on each piece that I designed. It stores the major choices I made.

With this data base, I will try to write a program to analyze the choices that I make. Eventually, I can see a program with a little intelligence which would communicate with the artist to suggest new ways and new directions.

For instance, the computer might say, "I noticed yesterday you were working on these kinds of pieces . . . Would you like to try something just a little bit different?" nu

Howard Ganz,
computer artist and philosopher

Illustration by Michael Haasis

SHARING THE SKIES

THE HIGH SEAS OF WORLD AIR TRANSPORTATION

Floyd D. Hall

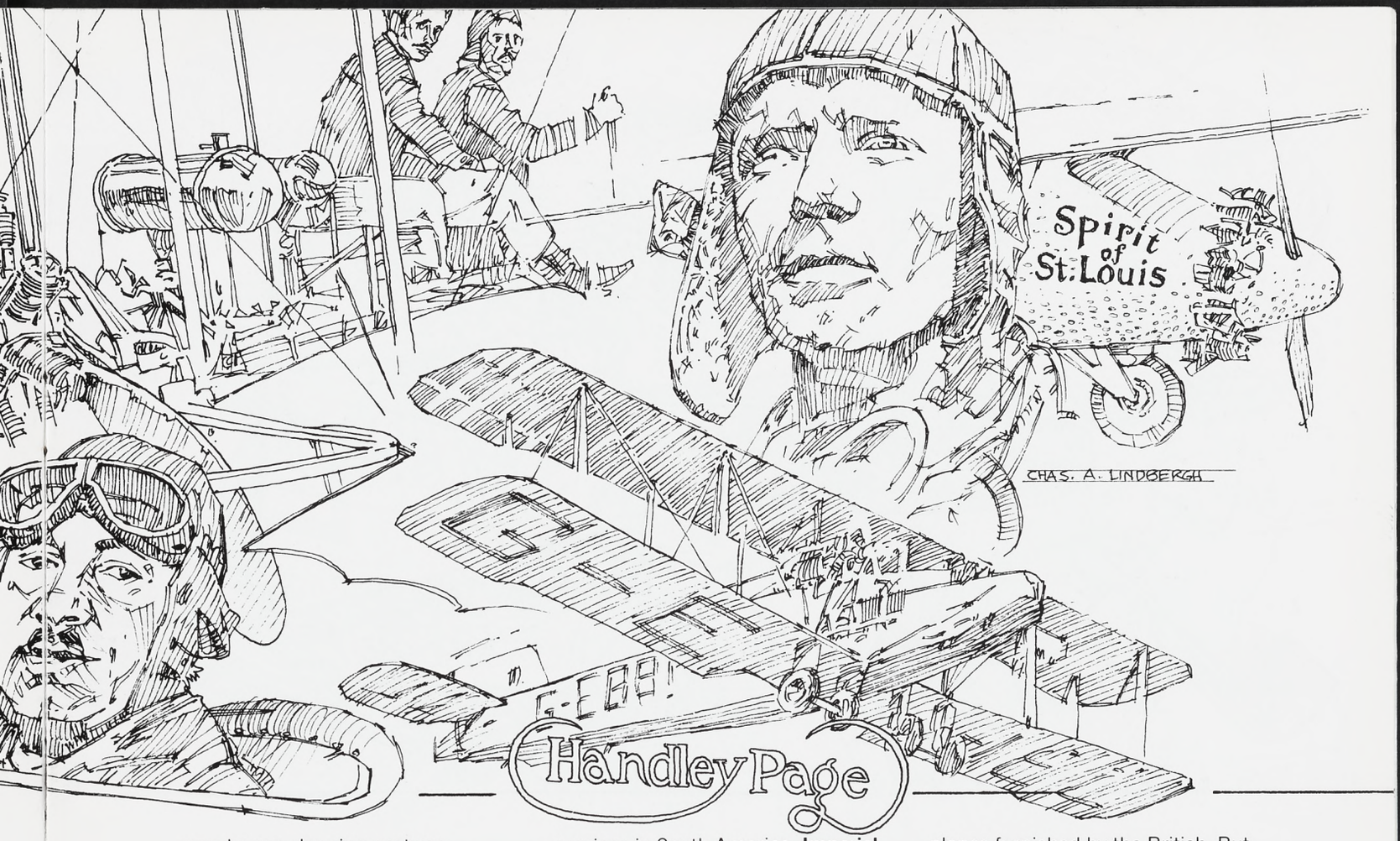
presented at Northrop University
School of Law
Aviation Law Symposium

When it became apparent that man had, at last, found a way to propel himself through the air in a powered flying machine that might some day transport both people and goods from one country to another, the decision as to who owned the air became a question. It was not a matter of urgent international concern, but when Englishmen began to fly to France and Frenchmen flew to England, the question kept cropping up as to whether they needed permission to do so.

In 1910, a conference was called in Paris to talk things over. There was nothing to guide them except the age-old precedent for "Freedom of the Seas."

France proposed that the air be considered one giant ocean with no boundaries and no barriers, such as continents or islands, to interfere with aerial navigation. The British and the Germans, on the other hand, took the position that they had proprietary rights to the air above all of their possessions, world-wide, and anyone who wished to fly through their air space could do so only after obtaining their permission. The Americans were not participants in the conference.

The First World War, however, changed all that. Airplanes became instruments of power. The giant Handley-Page bombers of England, the Gotha of Germany and the Caproni of Italy, while still primitive machines by today's standards, could carry a payload of fifteen hundred pounds, four to five hundred miles. To men of vision, it was not difficult to translate bombers into carriers of people, mail and freight. The continent of Europe suddenly became smaller and even while still locked in the desperate struggle of the war,



men began planning postwar airplanes for commercial use.

In 1919, another conference was called in Paris, and while there was no international accord of a formal nature, an agreement was apparently reached that permitted the establishment of air service between France, England, Germany and Italy. Compared to the feeble if heroic attempts to adapt airplanes to commercial uses in the United States, the Europeans were far ahead, and their early experience would soon lead them to foresee air service to their far-flung colonial empires. It was not until Lindbergh's flight across the Atlantic that American designers, manufacturers, bankers and entrepreneurs hurried back to the drawing boards and the United States become seriously concerned with commercial air transportation.

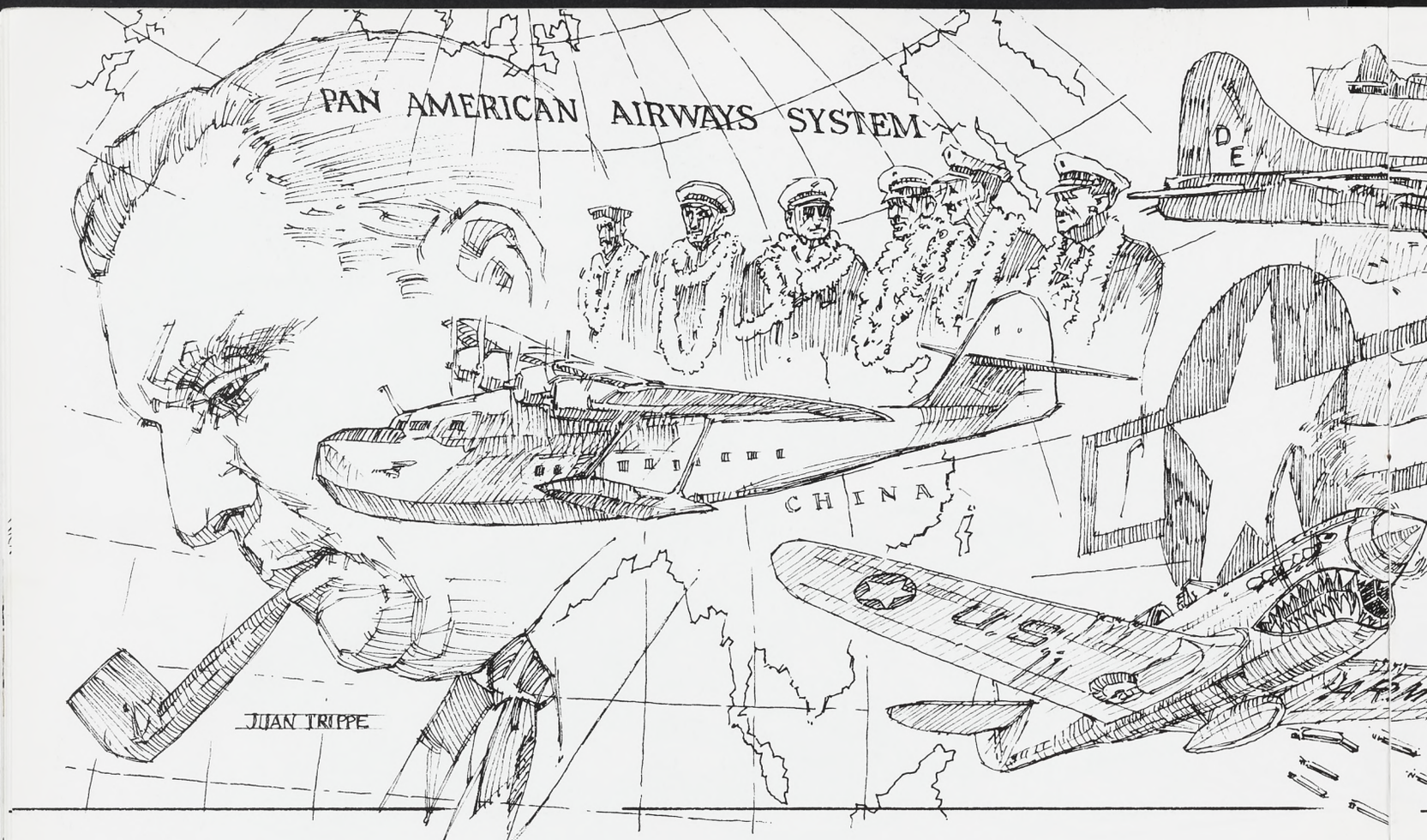
In the thirties the airlines of Europe moved steadily across their empires, and even to some places where they hoped to establish new colonies. **Deutsche Luft Hansa** became the leading airline in Europe, spreading out all across the continent from its base in Berlin. It extended as far east as Teheran and what was then called Persia. It organized extensive air services in South America. **Imperial Airways** of Britain covered its own empire and all of Africa and the Far East, while the Dutch, through **KLM**, grew rapidly into a large international carrier to its own colonial possessions. By the early thirties, **Air France** had become the major air carrier in West Africa and was soon to extend itself from Dakar to the east coast of South America and as far south as Buenos Aires.

The United States was not completely left out of the international picture however. Juan Trippe quietly, and carefully, with considerable help from President Hoover himself, expanded tiny little **Air Florida** from its initial operations between Key West and Havana to a new company, **Pan American** Airways, that would encompass the entire Caribbean Basin and extend south along the east coast of South America. **Panagra**, a Pan Am affiliate, was awarded a mail route from the Panama Canal Zone to Argentina.

By the mid-thirties, Pan Am and British Imperial Airways concluded an agreement to establish an experimental transatlantic crossing by way of Bermuda, using specially equipped long-range sea planes furnished by the British. But by May 1939, Pan Am operated its own transatlantic service with a Boeing 314 Flying Boat to Lisbon and Marseilles carrying only mail. In June, they extended their transatlantic routes across the northern Atlantic by way of Newfoundland to England and on July 8th inaugurated passenger service to London. The fare, incidentally, was $375 one way, $675 round trip.

With the beginning of World War II, all efforts were turned to military service. Air transportation by the European countries under German control was suspended indefinintely while German and British operations were devoted to their military needs.

Sometime early in the course of World War II, Mr. Harry Hopkins, representing President Roosevelt, reached an agreement with Britain's Prime Minister Churchill that England would concentrate her manufacturing capabilities on fighters while the United States would employ most of its resources in building large long-range bombers and transport airplanes. The result of this division of labor was that the Americans, when World War II ended, would be well prepared with long-range transport



technology while Britain would be considerably less well prepared. The rest of the world, of course, would have no capability to operate at all. In the imagination of strategic planners, the airplane would shrink the world so much as to make every part of the world available to all others on earth. Leaders of various countries believed future air transport would be a badge of prestige, and a way to gain extraterritorial prominence.
But it was equally clear to the planners that by the time the war ended, the United States would own most if not all of the long-range transports and they feared that the United States would overwhelm commercial air transportation on a worldwide basis. As the industrial might of the United States began to tilt the scales of combat toward the defeat of Germany and Japan, this matter became an issue of deep concern.

In the late twenties and through the thirties, most of the agreements for air service between the United States and other countries had been negotiated privately by the operating companies themselves, with the U.S. Government playing a passive and permissive role. On October 15, 1943, however, the United States announced a new policy. Henceforth, routes and rights for air transportation would be negotiated by the State Department, in close collaboration with the Civil Aeronautics Boards. Thus, the stage was set for action by and between governments in anticipation of the ending of the war.

In late summer of 1944, the United States invited fifty-five nations of the world to attend a meeting to be held in Chicago on November 1st. Fifty-one nations sent more than a thousand delegates and advisors. In an unusual departure from past practices, the conference was to be conducted in English and Russian, rather than the Customary English and French.
The Russian delegation, *however, got as far as Fairbanks, Alaska, and then mysteriously turned around and went home.* They did not attend the conference and no explanation was given. Although they participated in the United Nations, *they did not join the International Civil Aviation Organization (ICAO)* until November 1970.

Former centers of international coordination on aeronautical matters had been located in Paris, and although their scope of work was largely devoted to matters of air safety, the question of location of a permanent headquarters for Civil Aviation became almost an obsession with the U.S. delegates. They strongly believed that it was imperative that the new location should be somewhere in the New World, since unquestioned leadership in commercial aviation would certainly rest with U.S. air carriers.

Canada and Cuba vied for the honor of being the location of the new world center of civil aviation. Ultimately, Canada was chosen and, from the perspective of world power politics, was quite acceptable since it was a member of the British Commonwealth of Nations.

The United Kingdom, joined by Canada and all the other Commonwealth Nations, plus most of the European delegates, leaned heavily toward some sort of restrictionism. They suggested government dictation in advance of specific air routes, rates and fares and conditions of service. This philosophy was destined to be the major stumbling block of the conference and it would persist for years to come.

Australia, with strong support

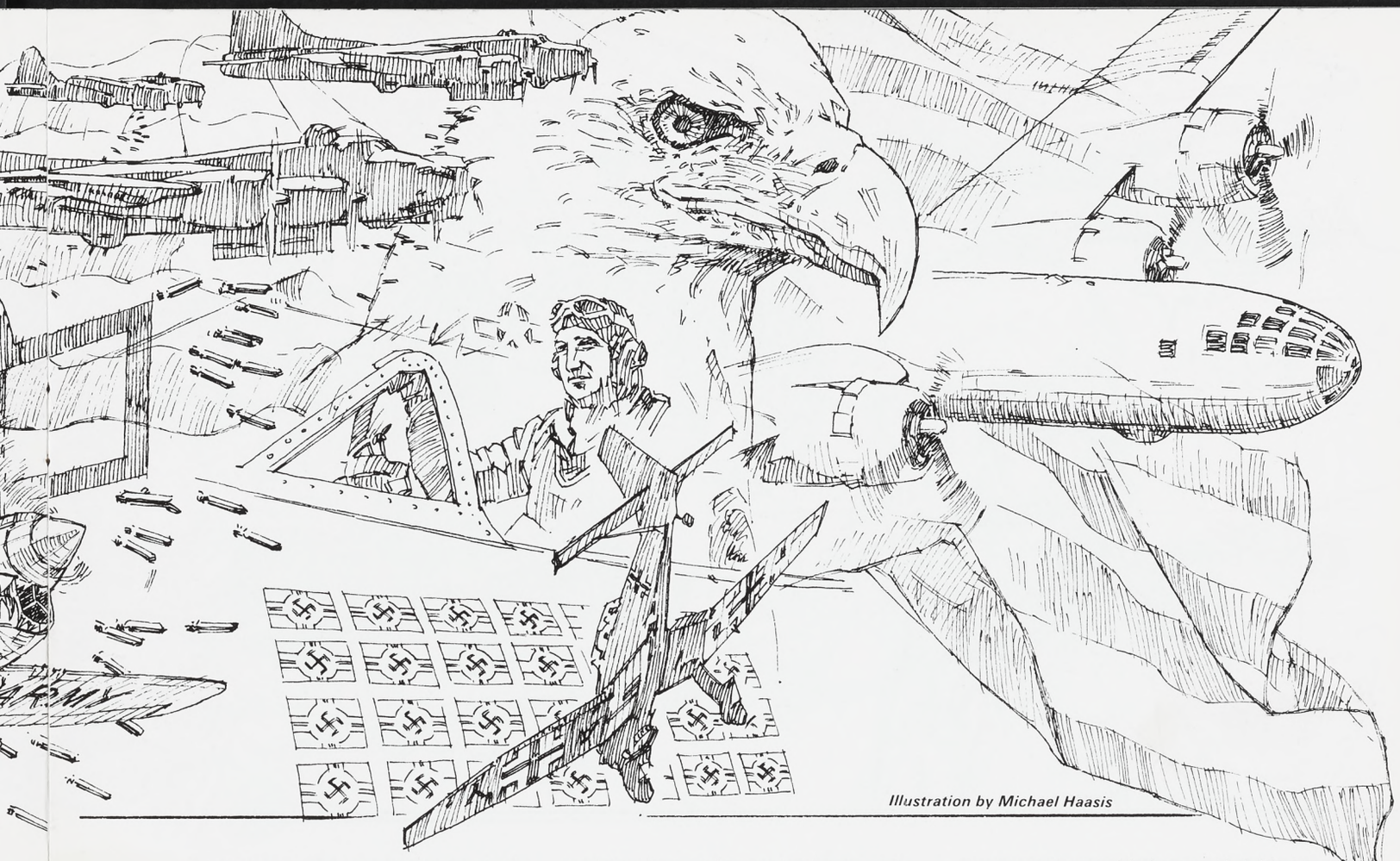


Illustration by Michael Haasis

from New Zealand, proposed a single, worldwide service to be jointly owned by governments and operated by personnel chosen from the countries that owned it. Of course, this proposal again met with strong opposition by the United States and it was soon tabled. Still, the idea persisted in various forms in the hallways and cloakrooms of the Conference. Finally, its sponsors and their dedicated supporters, one by one, sadly gave up the lost cause.

Then the United Kingdom, again joined by Canada, proposed an International Civil Aeronautics Board. It would have absolute authority over routes, who operated them, rates and fares, and a broad spectrum of competitive practices. The British, and most of the other countries, professed fears that strong United States private carriers would flood the markets with capacity and would offer very low air fares that would ultimately freeze out the carriers of the rest of the world.

Of course, the United States Delegation was adamant in its opposition to this proposal, too, and it appeared for a time that the conference would be unable to agree on anything of substance. But an outstanding and important proposal was soon to follow.

It was called "The **International Air Transit Agreement**". It proposed that, by multilateral agreement of the nations of the world, peaceful, civil-air transit through their airspace should be permitted.

Section 1 of that agreement provides that ". . . each contracting State grants the following freedoms of the air in respect of scheduled air services:

1) The privilege to fly across its territory without landing;
2) The privilege to land for non-traffic purposes."

The agreement was signed and ratified by 92 nations of the world and is in effect even today, providing an enormous benefit to world civil air services, and it is the foundation for many other agreements that followed.

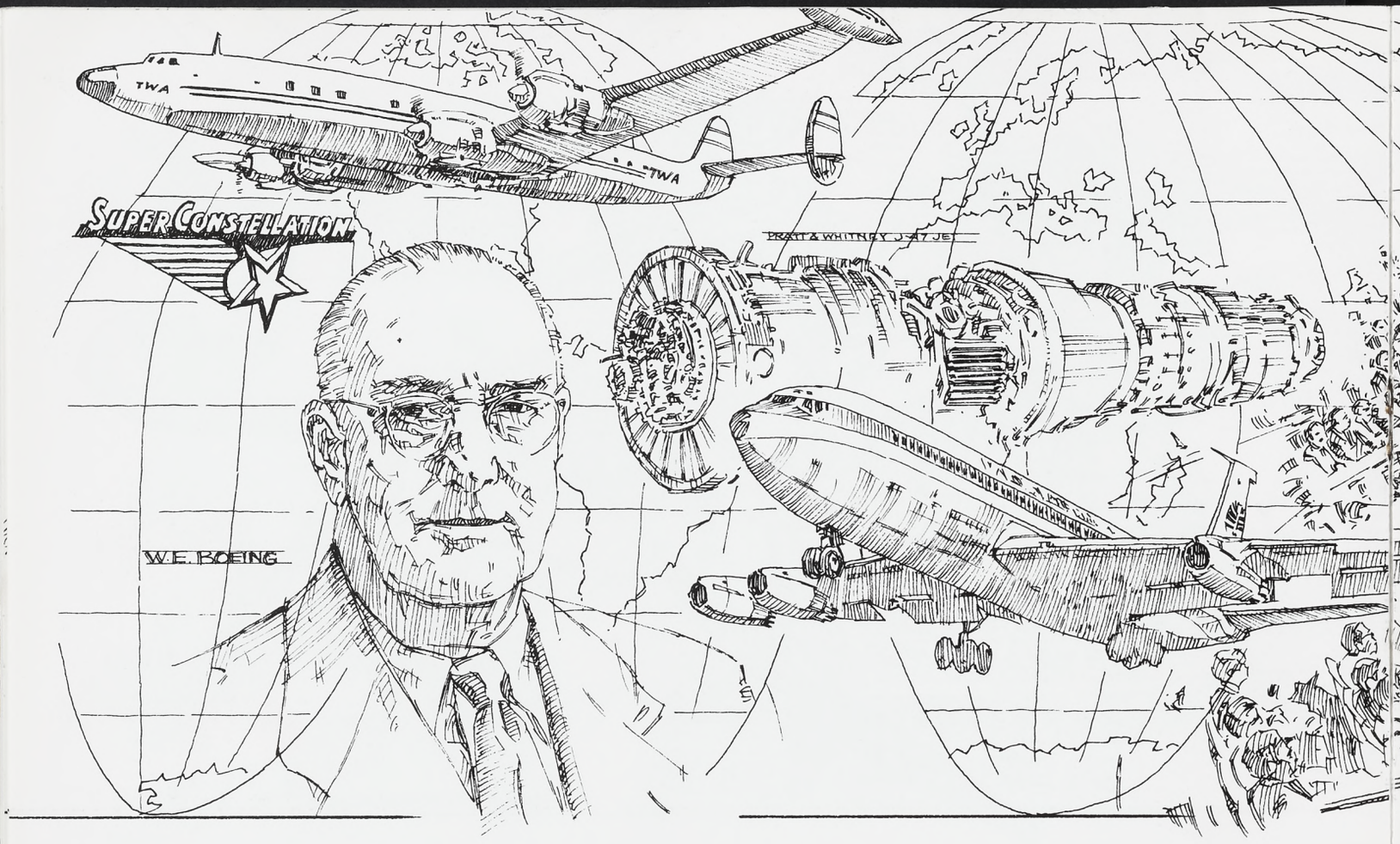
The United States made another proposal for action on a multi-national basis. It was called the International Air Transport Agreement, sometimes called the "**Five Freedoms Agreement**".

The United States proclaimed an open opportunity to the carriers of all other governments to establish routes to the United States if other governments would give equal rights to our carriers. If the other nations had agreed, the United States airlines were prepared to immediately begin service over the routes that had been established by the Civil Aeronautics Board. In return for the open invitation to serve the United States, however, our airlines must not be held up or delayed in starting their operations until the carriers of other countries were prepared to begin their own operations.

As the conference proceeded, this position was sharply challenged not only by other governments fearing it was just another means of gaining American dominance in air transportation, but also by some members of the United States. They suggested that a policy of bilateral negotiations would better serve American purposes.

The advocates of the latter position won the day and the Agreement was never ratified in the United States.

To some, the Chicago Conference was a failure, but those who took such a negative point of view could hardly have given proper weight to the incredibly restrictive barriers that had been in place for twenty years before



the Chicago Conference. The **International Air Transit Agreement** was a major reversal of those restrictions, and although the Air Transport Agreement was never successfully implemented, it established for all time the Five Freedoms that were incorporated into every bilateral agreement later concluded by the United States.

Following the 1944 Chicago Conference, the United States urged the United Kingdom to the conference table to negotiate a bilateral agreement covering air transportation between the two countries. But the British were not ready. They were not prepared, they said, *to open the skies to the powerful United States operators until they had been able to prepare their own air services for competition.* The United States was persistent, and had some powerful cards to play in the game, if it became necessary.

Financing the enormous costs of World War II had left the British in the *worst financial crisis of its history.* Britain proposed that the United States extend a line of credit of $3,750,000,000, in addition to the $650,000,000 already owed under the lend-lease agreement.

The proposal set off great political battles in congress and much criticism from the people of America, as well. The Wall Street Journal called the proposition "Ballyhoo for Britain".

By late 1945, the arguments and debates over the financing plan had become white hot and the British, embarrassed because it appeared they were holding up many air agreements by their reluctance, and because they were most anxious to settle the financial question favorably, suddenly switched tactics. They called for the United States to meet with them in Bermuda in early January 1946, to discuss two major topics: military bases in the Caribbean and the North Atlantic and the new, long-sought bilateral air transport agreement. The agreement over the military bases was easy, but the British still wanted some restrictions in air transport operations and those negotiations proved more difficult.

The British wanted at least some control over capacity and over rates and fares. They wanted these issues settled by governments before the agreement was completed, so that the Americans would be prevented from waging an uncontrolled price and capacity war. The United States opposed those objectives, not only in principle, but also because the United States had no way to control rates and fares of their international carriers. When the Civil Aeronautics Act of 1938 had been passed, it provided for the control of domestic airlines in routes, rates, and fares, but it was silent as far as international airlines were concerned. Congress had not given the authority to any other U.S. agency either, and the negotiators at Bermuda had no way to implement the British request, even if they had wanted to do so.

The British then proposed an association of airlines to set and control air fares as opposed to the wholly unilateral approach suggested by the United States. Since the United States had no way to exercise control over its own international carriers, it sought some compromise that might meet the British requirements, while preserving the U.S. principles.

During the Chicago Conference, there had been several discussions of airline organizations that might be formed along the lines of the **Air Transport Association of America**, headed at the time by Stuart G.

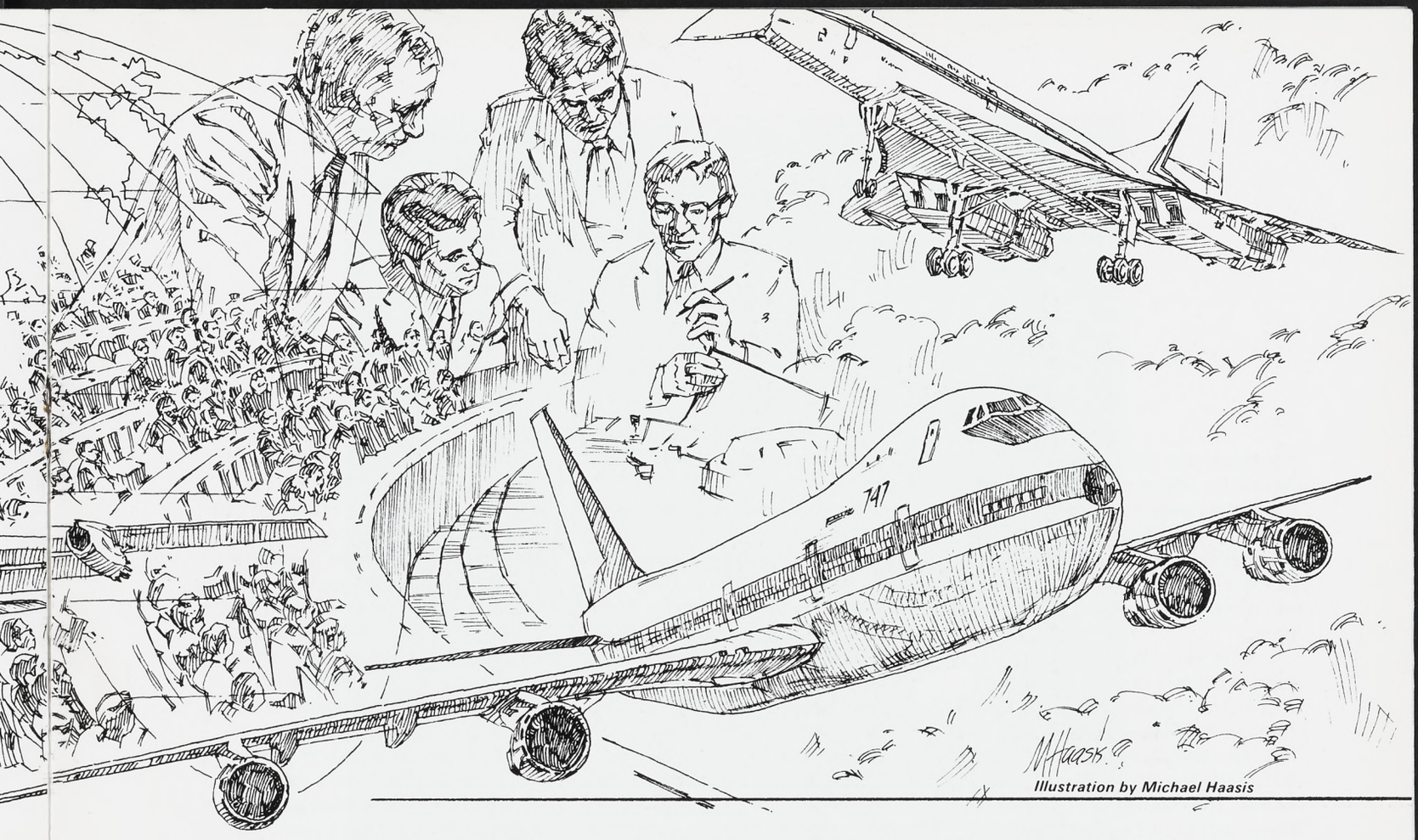


Illustration by Michael Haasis

Tipton. The ATA was highly respected in Washington for its integrity and for the leading role that it took in solving airline problems without legislation every time a controversy arose. After the Chicago Conference adjourned on December 7, 1944, representatives of some of the airlines that would become international airlines met with Tipton and discussed the way to organize an international association similar to the ATA.

It was only a few months after the close of the Chicago Conference that the new IATA became a reality.

IATA was promptly labelled as an international "cartel". Webster's Dictionary defines a cartel as "a combination of commercial enterprises designed to limit competition". IATA did not qualify for that label because the airlines in the organization were not independent of national owner-government policies. But, cartel or not, under the laws of the United States, U.S. airline representatives could not even meet with other international carriers to discuss competition, or any phase of it, without first having been granted immunity from the antitrust laws, an immunity that the Civil Aeronautics Act had authorized the CAB to grant, under certain circumstances.

Ultimately, the approval of IATA by the CAB was the only method by which the CAB could control the rates and fares of its international airlines, until Congress passed legislation giving it that authority. And when all other efforts failed to break the deadlock at Bermuda, the CAB approved the IATA organization as the instrument to settle international commercial problems including rates and fares and conditions of service subject to the approval of the CAB before any such agreements could be implemented. The CAB also agreed to ask Congress for legislation to give it direct authority to set rates and fares itself.

The issues of restrictionism and control versus totally free competition among airlines were fought over with vigor at Bermuda. Eventually the United States won its point on the right to pick up passengers in any foreign country and carry them on to another foreign country and compromised on the matter of rates and fares by agreeing to try the IATA machinery for a period of one year. **The Bermuda Agreement** itself was never considered a model document, but its provisions lasted for more than thirty years. The IATA machinery worked reasonably well for 30 years and *even today is considered by some as the best solution to very difficult problems.*

In 1926, a conference was called in Paris to discuss planning the extension of services to countries of diverse cultural development, as well as widely differing legal systems, *the need for an international treaty to set the limits of liability to the air carriers was urgent.*

A second conference was called in Warsaw in 1929 to draft a treaty to be submitted to participating countries. It should be noted here that the United States did not participate in either of these conferences, although observers were sent by the U.S. Government. The results of the conference in Warsaw became known as the "**Warsaw Convention**" and the basic provisions of that treaty have remained in force since its formulation in 1929.

The limits of liability however, have been changed several times. The original limit of liability was set at 125,000 French Francs or about $8,300.

In June 1934, President

"Recent crises among U.S. airlines, as well as radical changes in U.S. government policies, place the future of international air transportation in question."

Roosevelt sent the Treaty to the Senate for advise and consent, and the Senate gave its consent on July 31, 1934. President Roosevelt proclaimed U.S. adherence in October 1934, and the U.S. has remained an adherent since that time.

After World War II, representatives of several countries met at The Hague and agreed through **The Hague Protocol** that the liabilities should be doubled (about $16,000). The United States never ratified The Hague Protocol, but on November 15, 1965, President Johnson stated that the U.S. planned to denounce the Warsaw Treaty. At the same time, the U.S. let it be known that if the liability limit was raised to $75,000 the U.S. would consider withdrawing its denouncement.

The U.S. action provoked a new conference that was held in Montreal in 1966, where the liability was raised to $75,000. In effect, the **Agreement of Montreal** provides absolute liability on the part of the air carrier unless it can be shown that the injured party, through his own actions or negligence, caused the death or injury to occur. Further, the airline limits of liability can be exceeded if negligence, or failure of the airline to fulfill proper operating procedures can be shown to have occured. The CAB approved the Protocol as being in the Public Interest and it was adopted.

In 1971, many governments, including our own, recommended that the limits of liability be increased again and representatives met in Guatemala City to propose an amendment to the treaty. On this occasion, the limits of liability were raised to $100,000 and the ability of the passengers to raise the limits even above that figure were broadened.

The Guatemala Protocol has never been approved by the U.S. Senate, although it is presently on the calendar for action. It has been delayed by recommendations to extend the Warsaw Convention and all of its provisions to include the manufacturers of airframe and engines, against whom legal action could be brought under certain circumstances.

Most observers believe that the latest revision of the Warsaw Treaty will be passed by the U.S. Senate and that other countries will ratify the new provisions. There has been some discussion among foreign countries that if the U.S. fails to ratify the latest revisions (including the airframe and engine manufacturing provisions) a whole new treaty may be proposed. The heavy preponderance of U.S. citizens on all carriers of the world make it unlikely that the U.S. will ignore some form of no-fault liability provisions. Some elements of the legal profession believe that there should be no limits of liability and that all such matters should be settled through litigation. The American Bar Association, however, has endorsed the Warsaw Treaty as an orderly instrument of legal procedure that is of benefit especially to air travellers of the United States.

Recent financial crises among U.S. airlines, as well as radical changes in policies by the U.S. Government, places the future of international air transportation in question. Many U.S. airlines that were once powerful forces for international competition have been forced to restrict their operations and withdraw from markets they had previously served successfully. It is unlikely that agreements like those made in Bermuda will ever be made again, and the question of how rates and fares, and conditions of service can be controlled or even opened to free competition, continues to elude both the international air carriers and their governments. A once efficient, highly organized system of transporting passengers, mail and cargo around the world has been engulfed in confusion and there seems to be no place to turn for answers. The accumulation of a body of "air law" over the past forty years appears insufficient to supply the answers to the problems of recent years, yet increased regulation by the United States Government or the governments of other countires does not seem likely or even desirable. nu

Floyd D. Hall, past President and Chairman of Eastern Airlines from 1963 to 1976, is considered one of the founding fathers of the airline industry. After twenty three years as a pilot for Trans World Airlines, and twenty years in airline management, Floyd D. Hall became the first Chairman of the International Air Transportation Association. He is currently writing the inside story of the growth of Eastern Airlines, from Eddie Rickenbacker to Frank Borman.

Pete Regina's Shangri-La

SAGA OF THE SHANGRI-LA

THE LAST FLYING P-51B

The British called it the 'Mustang.' It was the American warbird that defended Britain, went in with the bombers to conquer Berlin, took on the 'stukas', and zeroed in on Mitsubishi's 'Betty's.' In 1944, General 'Hap' Arnold called it 'the finest fighter plane available.' After World War II, Reich Marshall Goering told the press, 'The first time your bombers flew in over Hanover escorted by fighters, I began to worry. When they came with fighter escort over Berlin, I knew it was over.'

The P-51 Mustang holds its own as one of the most celebrated aircraft of all time. It was designed, built and flown by North American Aviation in just 120 days. By 1944, production

aimed at 500 Mustangs a month. A total of 14,819 Mustangs flew 213,873 missions in the European theatre alone, dropping 5,668 tons of bombs and downing 4,950 aircraft in the air and 4,131 on the ground with a loss of only 2,520 Mustangs. Today, they are the most numerous combat warbirds on the U.S. Civil Register. Of the one hundred still flying, most are the later P-51D variant with the bubble canopy. By the late 1950's, the last flying P-51B, the Merlin-powered Mustang, crashed. All the sleek razorback "Bs" had been destroyed by war, metal scrappers, or neglect. Only two museum models remain, one in the National Air and Space Museum in Washington D.C. and the other in Tallmantz Air Museum in Orange County, California. Twenty years after the war, there was not a flying P-51B left.

Fortunately for the history of aircraft, Pete Regina would not let a good airplane die in a scrap pile. After graduating from the Institute of Technology in 1965, and while working at TWA as an aircraft mechanic, Pete started looking for the pieces of a razorback P-51B. With aircraft manuals as references, he began what was called "an impossible job." The saga of rebuilding a P-51B, an aircraft originally designed and built in 120 days, took Pete Regina five years to piece together and fly. Today, his 'Shangri-La' is the only flying P-51B.

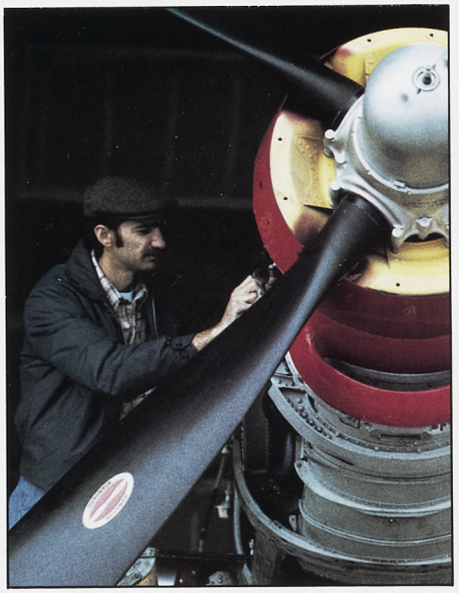
The search for parts and the rebuilding of the razorback Mustang is one more record-breaking tribute to the glory of the P-51. Its parts were scattered around the world. While in Israel helping rebuild a P-51D, Pete Regina found a wing of the "B" outside a technical school in Tel Aviv. He crated it up and sent it back to California where he made all new wiring and hydraulic lines. Wandering around the Oakland Airport he found the tail section of a P-51B in the corner of a hangar. It had been stripped of all accessories but the valuable formers were still intact. Pete added it to his mounting collection.

A new P-51B, made out of the parts and pieces of old razorbacks, was slowly taking shape. For the fuselage and fillets, Pete was allowed to take plaster casts of the preserved Paul Mantz razorback racer at the Orange County Tallmantz Musuem. He had aluminum sheet metal sections made from the exact angles and dimensions. Finding an original razorback canopy proved impossible, so Pete measured a museum example and built it from scratch. The center section of the fuselage had to be taken from a "D" model unit which was badly corroded. One of Pete's major challenges in the entire restoration project was the conversion of the center section of the fuselage to the built-up 'razorback' lines of the P-51B. The windshield was found in an aircraft parts warehouse and the rear panels

were flown in from Australia. Pete had to make the missing fuselage formers and stringers before he could begin attaching all the new metal pieces and the original parts. The entire 'labour of love' was done in Pete's garage.

When it was time to make the crucial connection of wing to fuselage, Pete managed to borrow space from Aero Specialties at Van Nuys Airport where he installed a new in-crate Merlin V-1650-9 engine, the famous 'sweet-sounding' Rolls Royce touch that allowed the P-51B a 40,000-foot ceiling. On the big day after all final checks, hardly a drop of hydraulic fluid escaped. The system performed perfectly. The new, unnamed P-51B waited for its final identity and Pete Regina chose the personal markings of the ace pilot, Don Gentile's "Shangri-la."

It was the Mustang's last authentic detail, its claim to fame.



Pete Regina with his brother's Mustang, a P-51D.

FORTY YEARS OF ALUMNI

In honor of the Fortieth Anniversary of Northrop University, the Tenth Anniversary of the College of Law, and the Fifth Anniversary of the Language Institute, the Alumni Association presents a collection of alumni letters to the University.

The volume and diversity of the letters reflects the wide variety of careers and interests within the 20,000 alumni of Northrop University. With graduates from over 68 countries, it is especially heartening to see that a collection of alumni letters includes responses from every continent.

It is the hope of the Alumni Association that these thoughts will provide inspiration to future graduates of Northrop University.

Edwin V. Stephens
President, Alumni Board
Aeronautical Engineering Technology, 1948
Bachelor of Science Aeronautical Engineering, 1964

ALUMNI LETTERS

48

Just to reminisce a bit, I attended Northrop Institute for aircraft and engine mechanic training June 1947 to June 1948. That's when the school was adjacent to the manufacturing plant on the Northrop Field. Our class group watched the first jet Flying Wing take off. What a thrilling sight — so sleek and so graceful.

I'm still working in aviation as I have since graduation from Northrop. My first six months were spent at United Airlines in San Francisco where four other classmates were also employed. My job was installing baggage compartment fire extinguisher systems on DC-6's.

Then I went to work at Hiller Helicopters in Palo Alto, California in April of 1949 and have worked on helicopters ever since. I worked for operators in Oregon and Alaska and then at Enstrom factory in Menominee, Michigan in 1969. Since 1972 I have worked for the Pasadena Police Department, Helicopter Section, where we operate three Enstrom F28C-2 for police patrol.

I have traveled to Guatemala, France, Switzerland, Egypt and Jamaica as well as many places in the United States. One of the highlights in my travels was personally meeting King Farouk of Egypt in 1950.

Albert C. Hutain
Senior Helicopter Mechanic
Pasadena Police Department

I graduated from Northrop Aeronautical Institute in 1948 with an Aeronautical Engineering diploma. I took the Northrop and other extension courses in San Diego and received my BSAE degree in 1970.

My entire career has been with Convair in San Diego. I hired in as a draftsman as did all engineers in those years. I progressed to Design Draftsman, Design Engineer, Sr. Design Engineer and currently am a Design Specialist.

Initially I worked in Preliminary Design for about 1½ years on propsals for the T-29, F-102, POGP and XF2Y-1 Sea Dart all of which resulted in experimental or production contracts.

Since the mid '50's I have worked in structural design in the space program, mostly on the Atlas and the Centaur.

Essentially every bit of airborne missile which is visible during a launch of the Atlas Centaur is what I helped design. This includes the thrust section, its separation mechanisms, propellant tanks, equipment pods, interstage adapters, payload adapters, insulation panels and up through the separable nose fairings.

Also, I am fortunate to be one of the few who go to Cape Canaveral in Florida and Vandenburg Air Force Base in California to assist with the launches.

Dick Frey
Senior Design Engineer
General Dynamics

49

My association began with Northrop Aeronautical Institute in early 1948 when I enrolled as an aircraft and engine mechanic student. I completed the course in 1949, received my FAA license and began to work at the main plant of Northrop on the B35/49 conversion project. This lasted until the "Big Cut-Up". Then I went to Lockheed to work on Connies, P2V aircraft and F94C Fighters. A short time later I was recalled to Northrop where I worked on all C125 aircraft then went over to the F89 line.

During this period, I read where Cal-Flyers was offering a course in Jet Engine Overhaul. While working at Northrop, I enrolled and became 50% of the first night class to complete the course. At this time, Cal-Flyers was contacted by General Electric for Jet Mechanics to work on an Air Force Mod. Program on J47 Engines to be located in the back of a small machine shop in South Gate (corner of Firestone and Atlantic).

I went with GE as a Jet Mechanic and finished my jet course after working hours. I later became a Test Cell Mechanic at their open Air Test Cell in Lomita. In December 1953, I was promoted to a Field Representative where I have worked ever since.

My assignments have taken me from Washington to Florida, Oklahoma, Arizona, China Lake, Edwards AFB, Chicago, New York City, Alaska and Viet Nam.

In 1973, I was assigned to commercial engines at LAX where I covered all foreign DC10 carriers and most of the domestic ones.

In January of this year, I was again assigned to LAX as Airline Rep. to Western Airlines on the CF6 engines and Flying Tigers on the CFM65 engines.

Tom J. Dozier
Airline Representative
General Electric Company — LAX

Presently, I am responsible for managing the design of the fuel control systems used on General Electric's CF6-61-50 and TF39 aircraft engine models. These engines power the DC10, 747, A300 and C5A aircraft. I have been associated with the General Electric Company for the past 31 years. Prior to this I started my engineering career with the Hunter Spring Company.

W.K. Gulick
General Electric Company
Cincinnati, Ohio

50's

I graduated with a diploma in Aero Engineering in February of 1951 and immediately joined Northrop Aircraft. The Flying Wings, the F-89 and the Snark! How well I recall the fly-bys, the test flights, the excitement of touching the very first plane I'd helped (in a small way) to design.

In 1956 with the patronage of Ed Schmued, I moved to the Aircraft Industries Association. This gave me an opportunity to expand my contacts in the industry to learn more of the role of engineering in the aerospace business. (Actually, it took Sputnik to make it an 'aerospace' industry.) In 1960 I graduated from Northrop University with a BS in Aerospace Engineering.

After a couple of educational years at Weber Aircraft in Burbank, I joined Battelle Memorial Institute in 1963 and spent a varied, rewarding fourteen years with that distinguished research organization. It was a step away from the aerospace industry, but that Northrop University education gave insight and perspective to even the most esoteric assignment. It was during my tenure with Battelle's Los Angeles office that I received, in 1969, one of the honors of which I am most proud: election to the Northrop University Alumni Hall of Fame.

In 1977 a deep personal conviction that our society's future depends on the wise management of its energy resources led me to join the Solar Energy Research Institute shortly after it was chartered. Participating in research on solar energy conversion must seem a far cry from the aeronautical engineering of the 1950's — and it is. But those same principles of practicality, and creativity, equally apply. And although the field is distant, I remain a dedicated aero engineer.

H. Dana Moran
Solar Energy Research Institute
Golden, Colorado

I retired from the aerospace industry in 1980 at the age of 44 after 24 years of work. My family is living in Northern California in a small town adjacent to a large lake and the airport. I have two Beechcraft Bonanza's and fly approximately 400 hrs per year.

George Loegering '56 BS Engineering
President
Loegering Enterprises, Inc.

Twenty years after my graduation from Northrop University, with a B.S. in Electrical Engineering, I am working on my sixth year at the Aerospace Corporation in El Segundo.

I started at Hughes Aircraft Company testing radar systems and components. *Later, I joined the Space & Information Division of North American Aviation building the command and service modules which would place men on the moon.* After Apollo, came the Nike Zeus project, where I started my career in telecommunications.

Interstate Electronics Corporation, provided me with an opportunity to develop two telemetry and tracking shipboard systems. The 1972 depressed job market forced me back to Hughes Aircraft Company where I developed third generation automatic test equipment for the F-14 depot. *I returned to North American Aviation Division of Rockwell to develop the ultimate in automatic test equipment for the B-1 bomber.*

After the cancellation of the B-1 bomber, I was accepted by The Aerospace Corporation to place single channel transponders, employing the most advanced communication techniques, on host satellites.

Richard S. Labonski
Member of Technical Staff
The Aerospace Corporation

I graduated from the Aircraft Maintenance Engineering Program in July 1956. *I then worked for the Rocketdyne division of Rockwell International for 21 years.* Most of that time was spent at Cape Canaveral on the Thor/Delta programs. I resigned as Responsible Representative on the Delta Program at Cape Canaveral in January 1978.

I resigned in order to start a training program to help prevent juvenille deliquency. This program is now called Behavior Effectuation and is provided by the BE Center, Inc. We presently have two facilities and are preparing to expand. We have graduated, as of this date, 29 young people who had been headed for a life of crime but who are now living as productive responsible citizens. None of these graduates have been arrested since graduating so we are able to claim a 100% success rate of our graduates.

Robert A. Lehman
President
Behavior Effectuation Center, Inc.

I was fresh out of high school when I entered pre-engineering in July 1955. My goal was to build aircraft as soon as possible. I graduated from the Aeronautical Engineering program in 1957 and immediately went to work for Rohr Industries.

I returned to Northrop University in 1959 to obtain a Bachelor of Science in Aeronautical Engineering. I then went to Martin Marietta in Denver, Colorado in missile structure and propulsion systems. *Next, I joined ACF Industries in Albuquerque, New Mexico, and did a great deal of diversified development and project engineering for atomic weapons.*

In 1968, I began work with plastic composites in jet engine applications for General Electric. I managed to do graduate work at the University of Tennessee and the University of New Mexico. I will most likely finish my career with General Electric as the potential is here.

James V. Timmons
Production Engineer
General Electric
Aircraft Engine Group

60's

After obtaining my Aeronautical Engineering B.S. in 1960, my career has included many exciting and challenging projects. The most significant were the Apollo project and the early design work on the Space Shuttle. *In 1978, after nearly 14 years in the manned spaceflight business, I entered the commercial/industrial arena. My company manufactures supervisory control and flow instrumentation equipment for the oil field, pipeline and electric power industries.* As you might imagine, there have been many technical and business challenges in such a varied career. My Northrop University "no-nonsense training" has held up well.

Robert L. Morris
President
Tejas Controls, Inc.
Houston, Texas

I am a principal Mechanical Engineer on the SOHIO produced Water Pumping Inst'l. at Prudhoe Bay, Alaska. This activity is being done by the contractor, Fluor Engr's Inc. in Irvine, Ca. My responsibility is to specify and procure the required fixed and mobile maintenance equipment (monorails, trolleys, hoists, bridge cranes, floor cranes, etc.)

Forty Years of Alumni

60's

I graduated from the Airframe & Powerplant program in 1947. After many years I was pleased to return to Northrop University to complete my undergraduate requirements and graduate in 1961 (Bachelor of Science, Aeronautic Engineering).

November 10, 1982, will be my 42nd anniversary of work in the industry. (That first job was as template maker for Lockheed — then Vega Airplane Co.)

Charles H. Swan
Piping Engineer/Designer
Fluor Corp.

After I received my Bachelor of Science in Engineering in 1961, I spent three years with Liquid Carbonic, responsible for technical sales, western region. In December of 1964 I joined Rockwell International (then North American Aviation) and I have been with the company ever since, in their Space Division. Over the years I have had various assignments, in engineering and later in financial. *For the past two years I have represented the Space Group in Washington for Department of Defense programs.*

Please extend my invitation to faculty and alumni who may someday be in the Washington area to please call; I would enjoy visiting with them.

Don Hegg
Rockwell International
Space Group, DOD programs.

The University has been in my thoughts almost constantly since my initial graduation from the B.S. program in Engineering Technology in 1962. Since that time I have earned a second bachelors degree in Psychology from CSULB and in 1980 received an M.S. degree in Management from Northrop University. *I am presently a doctoral candidate, engaged in course work, in a D.B.A. program at United States International University.*

I recently left the field of engineering, after seven years as a design group supervisor and three years as the Chief of Operations on a major space program, to assume my present, most challenging position as Manager of Technical Training for the Space Transportation and Systems Group at Rockwell International.

J.P. Mattei, B.S.E.T. (62) M.S. (80)
Manager
Technical Training
Rockwell International

In January 1965 I was employed by the Air Force Flight Test Center at Edwards Air Force Base as a Flight Test Engineer. In February of 1966 I transferred to The Boeing Company in Seattle as an Experimental Flight Engineer in the Flight Test Division. Since that time I have been involved in the development and flight testing of flight deck and systems design on the 727-200, 747, SST, AWACS, E4B Command Post, 747 Space Shuttle and 767. *The highlight of my career was being one of the flight crew on the first flight of the 767 on September 26, 1981.*

John P. Britt
767 Project Engineering
Boeing Commercial Airplane Company

I am employed by Hughes Helicopters, Inc. Culver City, California, where I have been working without interruption since completing the technology program at Northrop University in Aero Engineering in mid-1960. I came here to spend two years while completing my Aeronautical Engineering at night, with the intention of then going to work for a *real* helicopter company. As you can see, I have found a home.

My present assignment is Program Manager, Model 500E and 530E Development. *I have the program management responsibility for the development and FAA Certification of the two newest commercial products at Hughes.* Over the years I have served as Design Engineer, Flight Test Engineer, Project Engineer, Technical Marketeer and as Program Manager. I am appreciative of my "Northrop Tech" heritage for providing a solid background in my chosen career.

Rodney S. Taylor
Program Manager
Hughes Helicopters, Inc.

After graduating in 1967 from the BS in Aeronautical and Astronautical Engineering program, I went to work for Boeing in Seattle where I worked for two years on high energy lasers. I then went to the University of Washington to take my MS-AAE. I did my research in pulsed electric lasers. In 1971 I went to work at the Naval Missile Center at Point Magu, California in their high energy program. We then moved to Albuquerque in 1973, where I worked for the Air Force Weapons Laboratory in experimental high energy laser research, specializing in electric discharge CO lasers. In 1977 I started my own company.

Tetra Corporation is a small high technology research and development firm located in Albuquerque. *We specialize in high energy laser research, high power switch research, satellite environment analysis, and fluid dyanamics research, especially in the area of turbulence.* My own particular interests are in electric laser research, pulsed power systems, and high power switch research. This is a far cry from the aeronautical and astronautical engineering training I received at Northrop University, and yet that training has served me well in providing a foundation to enable me to pursue my interests in plasma physics and pulsed power.

William M. Moeny
President
Tetra Corporation

In October 1980, I had an opportunity to visit with Mr. Joe Miles in Dallas, Texas. We attended the AMFI Maintenance Seminar and managed to have a very interesting conversation.

For the past twelve years, I have been employed by Wayne Community College in Goldsboro, North Carolina. I am with the Aviation Maintenance Technology Department. I began as an aircraft mechanic and part time instructor. For the past 4½ yeras, I have been the Department Chairman of the Aviation Maintenance Technology Department.

Prior to that I was employed by Aero Industries in Richmond, Virginia. While there, I was a mechanic and repair station maintenance inspector.

Since I graduated from Northrop University in March of 1968, I went to work at Aero Industries right out of school.

I would like to thank everyone at Northrop University for the effort they put forth to prepare me for what has been a personally rewarding career.

Harry W. Blanchard
Department Chairman
Wayne Community College

I have just been named vice president of Sales and Marketing for Seneca Railroad and Mining, Inc. in an announcement by John E. Miller, President. I joined the Huron, Ohio firm after having been with Westcode, Incorporate, Philadelphia for the past seven years.

Gary McClure
Vice President
Seneca Railroad and Mining, Inc.
Huron, Ohio

NORTHROP UNIVERSITY COLLEGE OF BUSINESS AND MANAGEMENT WAS FOUNDED IN 1970

In the first 10 years since I graduated from Northrop University, I worked in a company named TECNOREMA located in Lima, Peru as Sales Engineer supplying equipment to mining concentrator plants in this country. In May of 1980 together with 2 partners I formed PROVEEDORA MINERA S.A. dedicated to the same type of business, where at present I am Vice President and Manager.

We are supplying equipment manufactured in the United States, Canada, Sweden, England and South Africa.

If any Northrop University alumni would like to visit Peru I would be very pleased to help in coordinating their visits and arrange for any meetings or visits they would like to have.

Anthony Davis, Manager
Proveedora Minera S.A.
Lima, Peru

Cargolux Airlines International congratulates Northrop University on its 40th Anniversary. You have certainly established a lasting position in aviation history. If one examines aviation history's most notable achievements, I am sure many Northrop University graduates were responsible or involved in the events which shaped the aviation and space industry. Our airline too, has benefited greatly from the education which approximately 20 of our employees received at Northrop University.

We wish Northrop University success, and hope the foresight will conitnue in the future educational requirements for an ever-changing industry. You have done a marvelous job in the past.

Jack Kooyman, (BSAMET 1972)
Director Maintenance and Production
Cargolux Airlines International S.A.
Luxembourg

NORTHROP UNIVERSITY SCHOOL OF LAW WAS FOUNDED IN 1972

My career, since graduation in Electrical Engineering, has been centered around systems development and test. These programs include Meteorological Data Buoys for the Italian Government (part of the "Save Venice" Program), Prototype and Production Environmental Buoys for the National Data Buoy Office, F16 Avionics Intermediate Shop for the Air Force, Ship Support Improvement Program for the Navy, and currently Computer Controlled Test Equipment in support of ATLAS/Centaur and Shuttle/Centaur for NASA. All Programs, except one, have been General Dynamics Programs. Each Program has presented unique challenges and each has provided individual rewards.

Darwin D. Saylor
Senior Electronics Engineer
Space Test and Launch Equipment
General Dynamics
Convair Division

I am very proud to be a member of the Northrop University family where I spent 2 years completing a Master of Science in Engineering.

After my graduation, I worked with Canadian General Electric, Peterborough, Canada from 1973-1976. Since 1977, I have been employed with Bharat Heavy Electricals Lts. Bhopal, India, one of the world-renowned companies in the field of electrical generators, transmission & transportation equipment. I am Deputy Manager in the research and development section of Hydrogenerators.

S.S. Rajagopal
Bharat Heavy Electricals Limited, Bhopal
India

I graduated in March 1975 with a Bachelor of Science in Aircraft Maintenance Engineering Technology and also earned my A&P License. I have been with McDonnell Douglas Corporation (MDC) since November 1978. I am a Product Engineer in the Product Support Technical Services Department of Douglas Aircraft Company in Long Beach. Prior to MDC, I was with Iran Aircraft Industries (IACI) as a Quality Engineer in the Quality Assurance Department.

Throughout my professional career, I have seen and felt the great respect which the aerospace industry has for Northrop graduates. Naturally, individuals must prove themselves on their own. However, being a Northrop University graduate makes this task substantially easier. I would like to go on record and thank you for this.

Robert Baitoo, Product Engineer
McDonnell Douglas Corporation
Long Beach, CA.

NORTHROP UNIVERSITY LANGUAGE INSTITUTE WAS FOUNDED IN 1976

Following graduation with a Masters degree in Electrical Engineering in 1976 I became interested in the nation's nuclear power industry. *I left my position at Hughes Aircraft Company, where I had been working as an electronics design engineer while pursuing my Masters degree, and accepted a position as Senior Engineer in the Reactor Control Systems Design Branch of EG&G Idaho, Inc., the prime contractor at the Idaho National Engineering Laboratory (INEL).* The INEL is the nation's lead laboratory in nuclear energy research and development, operated under the auspices of the United States Department of Energy. In 1979 I accepted a position as Supervisor of the Data and Control Systems Section of the Water Reactor Research Test Facilities Divison of EG&G. I am still serving in this capacity.

William B. (Brad) DeBow,
Reactor Control Systems Design,
EG&G, Idaho, Inc.

On graduating from Northrop University in December 1976, I attended Northwestern University for one year, where I completed my masters in Electronic Engineering. Presently I am employed with Ohio Medical Products as product engineer. *I am involved in designing anesthesia and respiratory related equipment*

Muslim Tyebjee
Product Engineer
Equipment Development & Engineering
Ohio Medical Products

I graduated September 1977 with a Bachelor of Science in Engineering Technology and have joined ALIA. THE ROYAL JORDANIAN AIRLINE CORPORATION in October 1977. Now I am in the position of Senior Engineer in charge of PRODUCTION CONTROL. Primarily, I am in charge of preparing and planning Maintenance Specifications, packages and job cards covering lower, intermediate and higher checks including airframe overhaul and structural inspection, for the B747, B727, B707/720 and L1011 fleets of 20 Aircraft increasing to 21 in November this year.

Oussama Salah
Senior Engineer
ALIA, The Royal Jordanian Airline

70's

Since graduating from the Institute of Technology in 1978 I have been employed in our own family business, John W. Hannay & Co., Ltd. which employs 200 people in Scotland.

The main activities of the company are waste paper processing and paper converting.

Anthony S. Abram, General Manager of Plant and Machinery
John W. Hannay & Co., Ltd.
East Kilbride, Glasgow, Scotland G74 5NE

Presently I am enrolled at the University of Wisconsin-Milwaukee. Since graduating from Northrop University in November of 1979 I have had the rare pleasure of working with Zantop International Airlines as a line maintenance mechanic. Later, I pursued employment with Challenge Air Transport, a FAR Part 121 air freight carrier operating from Miami, Florida and servicing the Caribbean and Central America. I performed the duties of a DC-6A flight engineer until being recently furloughed.

William E. Pick, A&P '79
Student
University of Wisconsin-Milwaukee

Since I earned my Bachelor of Science degree in mechanical engineering in 1979, I have been working for Modern Foundry Products Limited in Nigeria. I started as a castings engineer and am now the technical director.

My special regards and gratitude to Professor Able and all the staff of the Mechanical Engineering Department.

H.N. Jarmakani
Technical Director
Modern Foundry Products
Nigeria

I entered Northrop University School of Law in the spring of 1976, as Ruth Graham. I changed my name legally to Christina Grahame in 1980. If any of my classmates read this letter, I would like them to recognize my new name.

I am the sole practitioner of a law office here in Lakeport, California, a small town of 4,000 population on the shore of Clear Lake, California's largest lake.

I am the only woman lawyer in private practice in Lake County, and I am sure I hold the record for old age when I started law practice — I was 55 years old when I started my office here in August of 1981. (I was 51 when I entered law school).

Christina Grahame
Grahame General Law
Lakeport, Ca.

I, Mehrdad Azari, graduated from Northrop University with a Masters in Business Administration in June of 1980. After one year of working for Metropolitan Life Insurance Company, I and Mr. Tooraj Meshginpoosh decided to start our own international trade business in Playa Del Rey, California.

At the present our company is importing fine quality French wines and Italian leather shoes. Our firm has been very successful in marketing the products in fine restaurants in Southern California.

Mehrdad Azari
President
Azari International
Play Del Rey, Ca.

I am a graduate of the first Royal Malaysian Air Force's Applied Manufacturing Technology class. I attended the Airframe Mechanic course at the Royal Air Force Training School at Cardiff, Wales in 1971 and in 1974 I attended an Airframe Fitter's course at the Royal Air Force Training School at Halton, England.

When I came to Northrop University, I had a new experience. This was my first time doing a course outside the military establishment. What a relief!

When I graduated, I saw the difference between the English aviation technology and the American aviation technology. It is safe to state that basically both are comparable, but I would say the American aviation technology has the edge in that they are more aggressive. They cover more scopes and more subjects affecting the aviation industry. For example, in the Royal Air Force Training School, I was never taught welding, because welding is specifically for the welders which is a trade by itself.

I am working in a department called the Aircraft Servicing Flight at the Royal Malaysian Air Force Base in Kuala Lumpur. Besides the servicings of aricraft, I also give lectures to personnel regarding the latest information in the C-130H.

Kem. Zakaria
Royal Malaysian Air Force
Kuala Lumpur, Malaysia

80's

Since my graduation from Northrop University with a B.S. in Engineering Technology in 1981, I have been working for Martin Marietta Aerospace as a Senior Quality Representative to Southern California. *I am presently attending the College of Business and Management at Northrop University and will earn my Masters Degree in Management Technology in March 1983.*

Larry A. Crapo
Sr. Quality Representative
Martin Marietta Aerospace
Denver, CO

IN MEMORIAM

THE WORLD PEACE AWARD

Lakhdar Abdelmoumene
Mustpaa Karadja
Mahmoud Karboua
Abberahmane Matougui
Braham Moussouni
Mostefa Sbahi

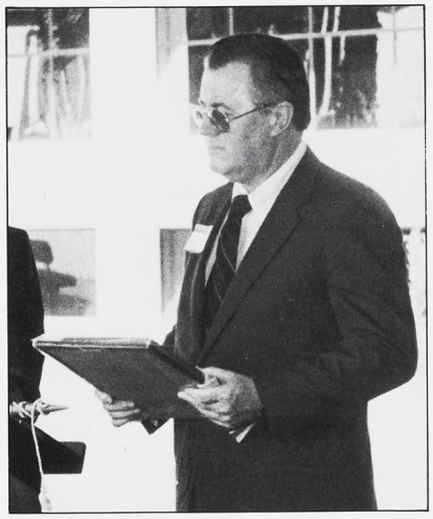
For their courageous participation in the successful efforts to free hostages from a foreign nation, the Alumni Awards Committee selected six Algerian alumni for the Northrop University World Peace Award.

During the American hostage crisis, these Algerian crewmen on the Algerian presidential airplane were instrumental in flying diplomats and doctors in and out of Iran during negotiations for the release of fifty-two American hostages.

On May 5, 1982, the University learned of the crash of that aircraft and the death of three of these skilled aviators. On the Fortieth Anniversary Alumni Day, Northrop University presented The World Peace Award to the Algerian graduates of the Language Institute.

AWARDS OF MERIT

On the Fortieth Anniversary of Northrop University, the Alumni Association chose to honor ten of its members for outstanding merits in four categories of achievement.

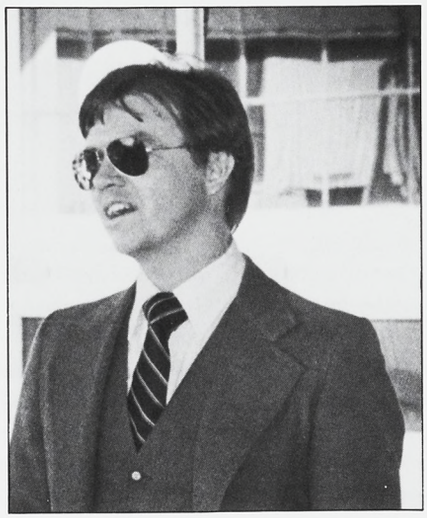


THE DISTINGUISHED ALUMNUS AWARD

William R. French

For his leadership in American industry and for his distinguished service to society, Northrop University Alumni Awards Committee recommended William R. French receive the Distinguished Alumnus Award. Over one hundred accomplished alumni were nominated by members of the association.

William R. French received a degree in Aeronautical Engineering Technology from Northrop University in 1951. He is currently Vice-President of Washington D.C. operations for the Chemical Systems Division of United Technologies Corporation. He has received the "Goddard Trophy" and serves as a leader in the National Space Club. Through his professional affiliations with the U.S. Air Force Association, National Aviation Club, National Security Industrial Association, and Cape Pioneers, he actively develops scholarship support for students in aerospace.



THE SPIRIT OF JACK NORTHROP AWARD

Stephen Ptacek

In recognition of his courage, ingenuity, and aviation skill, the Alumni Awards Committee recommended that Northrop University present Stephen Ptacek with The Spirit of Jack Northrop Award. As pilot of the SOLAR CHALLENGER, Stephen Ptacek made the historic flight across the English Channel in an aircraft powered only by the sun's energy.

Stephen Ptacek graduated from Northrop University in 1981 with a Bachelor of Science degree in Engineering Technology. He is currently flying DC-8's for Emery Air Freight.

THE FREE ENTERPRISE AWARD

Milo Friesen

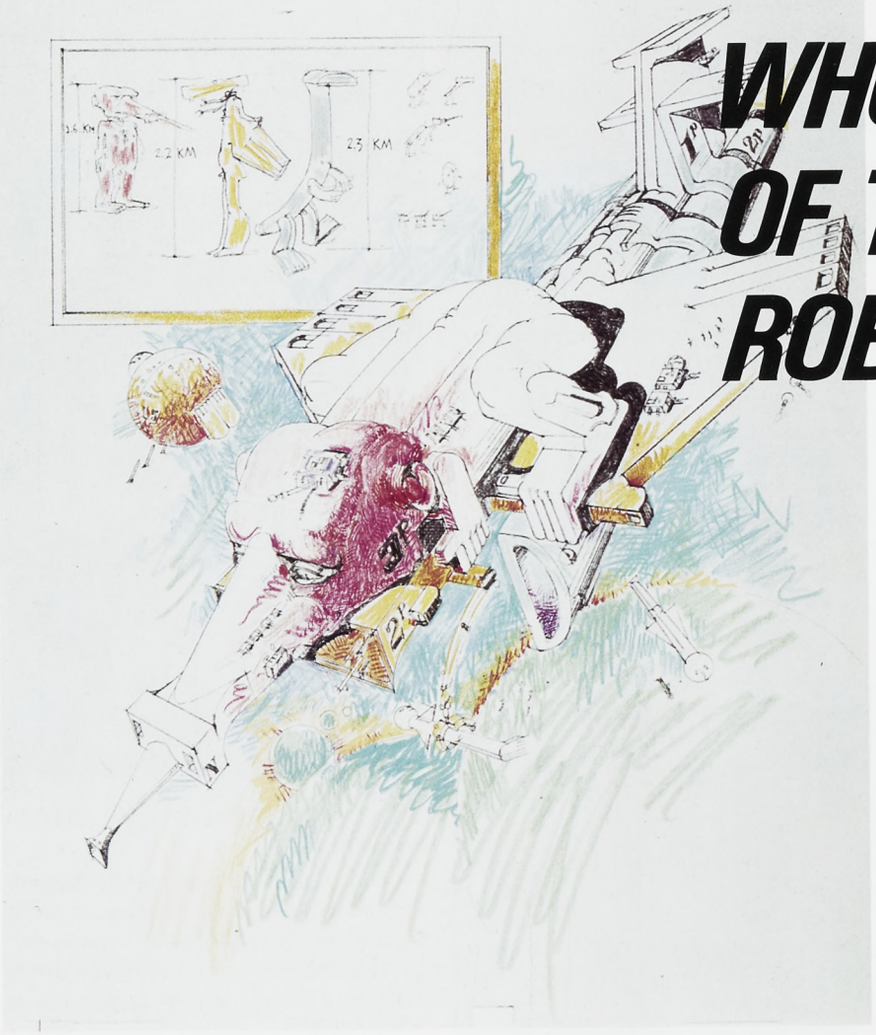
For his pioneering work in the field of industrial robotics, the Alumni Awards Committee selected Milo Friesen as the most deserving alumnus of the Free Enterprise Award. After his graduation in 1966 with a Bachelor of Science in Electronics Engineering, Milo Friesen contributed to the F16, Concorde, and Space Shuttle programs. His accomplishments during ten years in aerospace earned him a management position with Ransburg Corporation as General Manager of the Factory Automation Division, Cybotech.

Milo Friesen then chose a team of experts in automation from aerospace and varied industrial backgrounds to develop an advanced technology robot company. His project grew into a joint-venture with Renault of France and he assumed the presidency of that company.

In 1981, Milo Friesen was elected Corporate Vice President of Science and Technology for Ransburg Corporation where his responsibilities include strategic planning, market planning, product planning, and acquisitions.

Cybotech currently develops, manufactures, and markets a comprehensive line of robots throughout the Western Hemisphere, Asia and Australia.

Illustration *Bill Kinser*



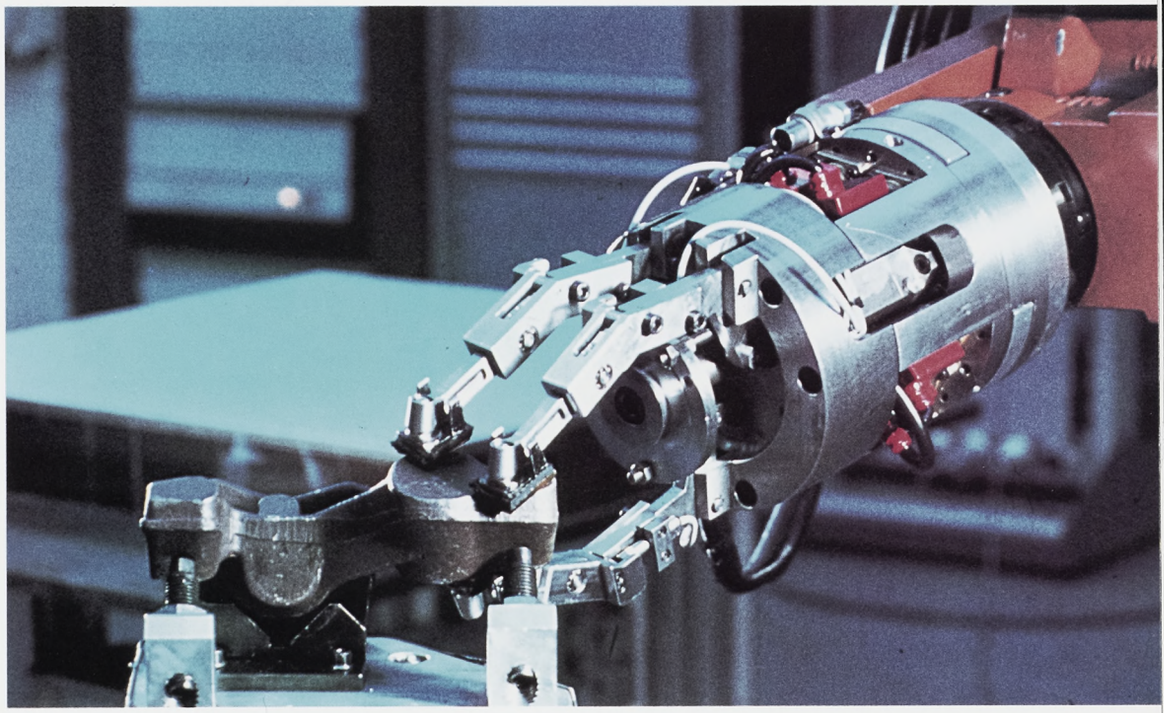
WHO'S AFRAID OF THE ROBOT RACE?

The fear of automation haunts labor, industry, and management. Robotics threatens to revolutionize the labor force, education, and the entire industrial base. By creating a robotics center, Northrop University prepares to help in the massive transition from labor-intensive industries to the automated systems of production.

For a look inside the factory of the future and an understanding of the stumbling blocks to automation, NUANCE interviewed the visiting robotics consultant, Milo Friesen, Vice President of Science and Technology at Ransburg Corporation. Northrop Aircraft's Factory of the Future (IFAC) provided an in-production demonstration of the problems and solutions offered by automated systems in manufacturing.

The radical shift from human to robot labor presents a special challenge to education. Foresight, planning and sensitivity to human factors can make the transition to automation less traumatic and costly. Private industry is already retraining blue collar workers for employment in service and repair of the automated systems, or for transfer to other industries. The Japan Engineering Academy is setting up that nation's first 'mechatronics' department to teach construction and operation of robots. Their first 200 prospective graduates have been overwhelmed with job offers. Universities and professional societies in the United States are also preparing for the robotics race. Northrop University plans to open an industrial robotics center where manufacturers and students can openly discuss and explore solutions in the new automated systems revolution.

A Cybotec robotic hand:
the vertical gripper.
courtesy Ransburg Corporation

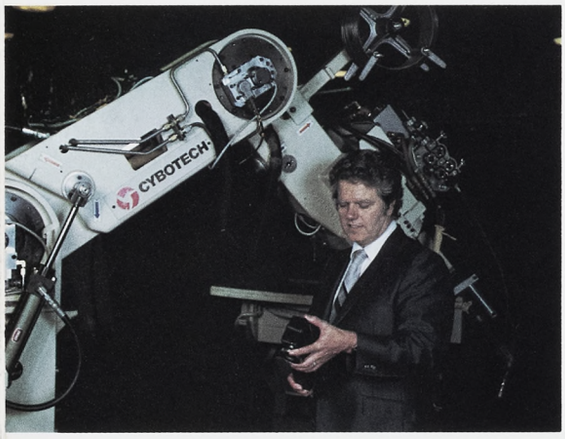


The robots are coming. They will be the new skilled labor that makes few mistakes, if any, in a round-the-clock work day. Powerful as cranes and yet sensitive enough to thread a needle, the new generation of robots will have a versatile array of human senses. They will be able to see, touch, hear, smell and even "think" about decisions. In some cases, they will reproduce themselves. In fact, the new race of robots will be tailor-made to take over the blue-collar jobs in welding, forging, drilling, assembly, spray painting, plastic molding, machine tooling, loading and unloading materials. Skilled human labor has already become a spectator in many heavy industries and on many assembly lines.

This transition to robotics inspires as much panic as it does enthusiasm. 20,000 industrial robots have already joined the work force around the world. 70% of these robots are in Japan where blue-collar jobs are slowly being eliminated. The United states has over 150 different kinds of industrial robots ready to revolutionize the entire manufacturing industry. Within ten years, robotics is forecast to skyrocket into a $5 billion industry. Manufacturers like IBM, General Electric, Westinghouse, and McDonnell Douglas are racing into the new product market to compete with the original robot makers such as Unimation, Cincinnati Milacron, and Prab.

As the cost of skilled labor approaches $25 an hour, the cost of industrial robotic systems is decreasing. It is gradually becoming more economical to introduce automation into the industrial process. Within a few years, the initial cost of investment in robotics will be off-set in short-term savings to production. When that happens, the rush to integrate robotics into the work force will be on. The impact will be felt at every level of society. New skills, new kinds of jobs, and new educational programs will be needed.

Planning for Automation



After graduating from Northrop University in 1966 with a Bachelor of Science degree in Electrical Engineering, Milo Friesen worked for Airesearch, Houdaille, Sundstrand, and the Ransburg Corporation. For more than ten years he worked in the preliminary design of aerospace turbine systems for the F18, Concorde, and the space shuttle. In 1978, he became general manager of a factory automation division of Ransburg and formed a joint venture with Renault of France to build the world's most advanced technology robot company. In 1981, he was elected Corporate Vice President of Science and Technology at Ransburg for strategic planning, market planning, product planning and acquisitions. Currently working with Northrop University to plan the robotics center, Milo Friesen spoke with Murray Teitell, Chairman of the Computer Graphics Department and Dr. Robert Canaday, Dean of the College of Engineering Technology.

One of the first, the Factory of the Future at Northrop Aircraft is designed to automate the handling of graphite in aircraft manufacturing. This working automation cell has produced over 475 graphite rudder skins for the F18 while reducing labor costs by 30%. The automated handling of graphite for giant structures promises to shift the emphasis of aircraft manufacturing from aluminum to graphite in ten years.

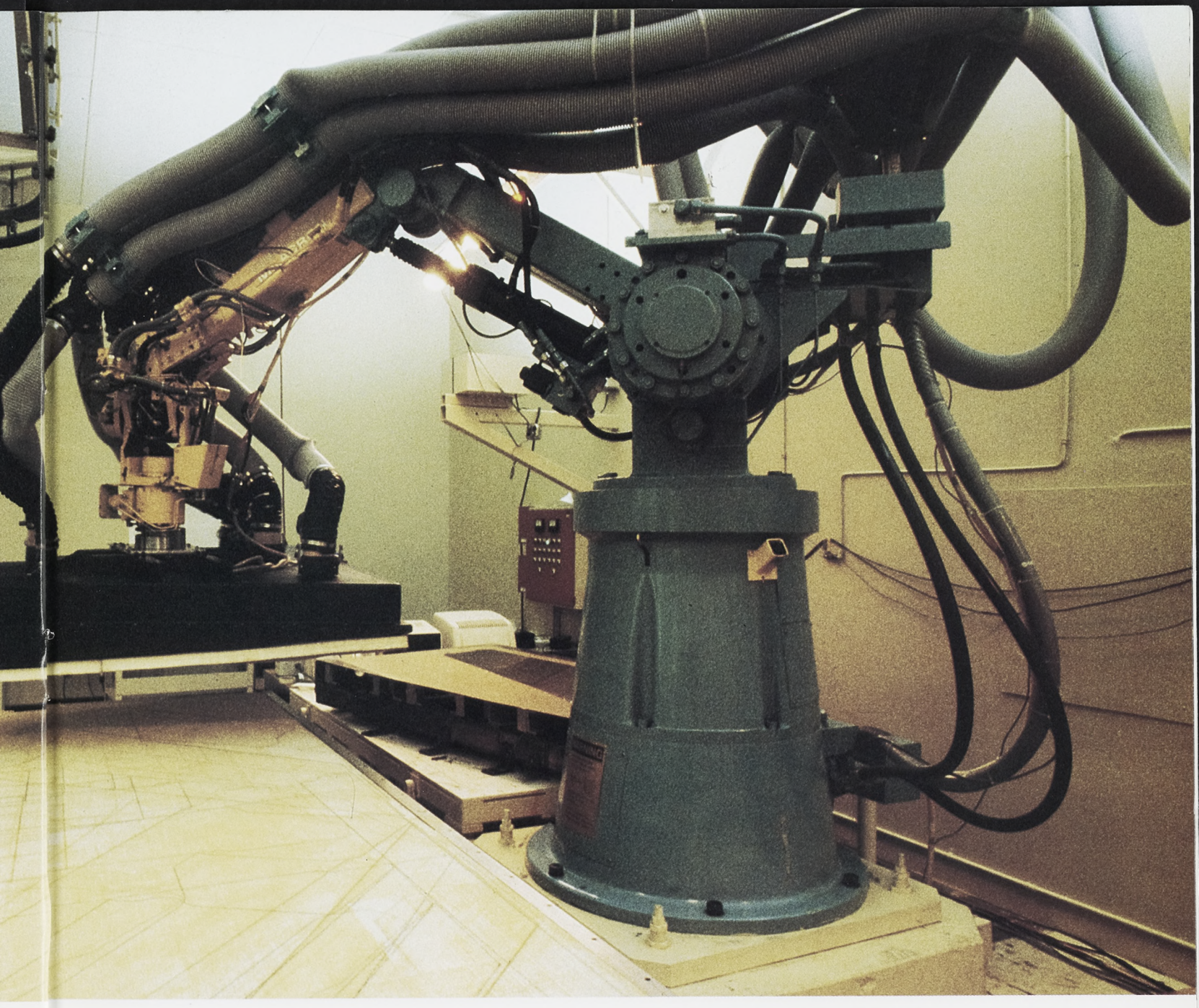
An interview with Milo Friesen

Can you explain what you mean by a factory of the future?

As the cost of microprocessing becomes cheaper, we will eventually reach a level where we can communicate everything electronically. This will eliminate the use of paper in the factory as well as many of the factory jobs. So, the factory of the future will be basic software packages of engineering concepts, planning, and production control. People will be needed only for improving the software, monitoring the process, and servicing the machines. Factory jobs as we know them will virtually cease to exist.

What will the new factory look like?

When you first walk into the factory,



you will have the impression that it is empty and the company is out of business. There will probably be some people greeting the arrival of raw materials as they enter the factory and some people on the other end of production blessing the final product. But in between, machinery will be performing every task.

The factory will look more hostile to people because it will no longer need to be air-conditioned or heated or lighted, except for the servicing of machinery.

For example, in an automated factory in France engines are produced for Renault, Volvo, and Peugeot at a rate of 1600 engines a day with only 400 employees. When you first walk into that factory, you think it is closed. You do not see anybody and you have no sense of any production going on except for the noise of the lathe cutting chips. Other than that, it is reasonably quiet with no people visible.

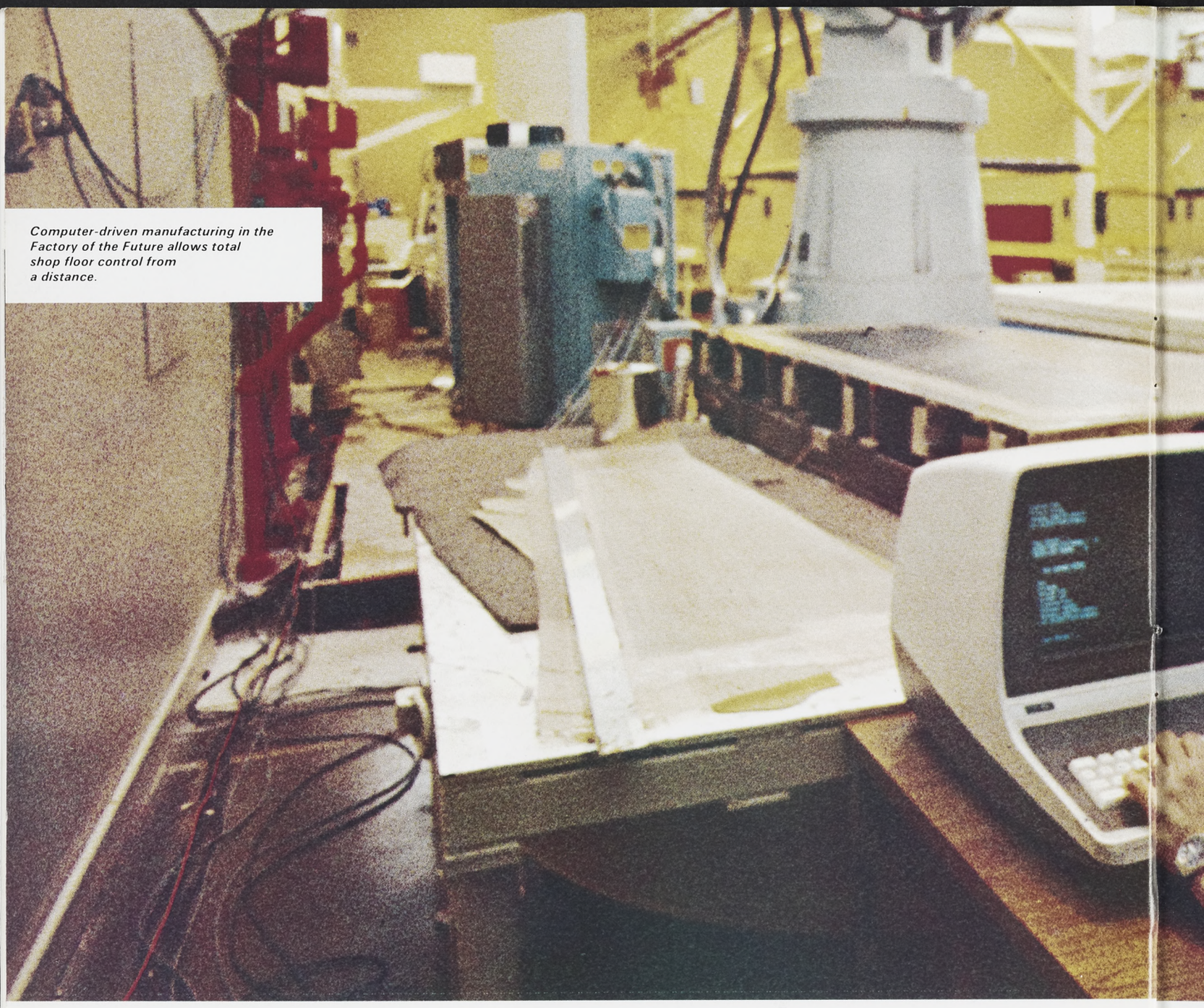
What kind of jobs will be needed for the factory of the future?

People will be needed to do service work. The service industry will grow much larger than it is today, even though it is already larger than the factory industry in the United States. Those people will need to know the electronic technician level of servicing and a little about mechanical and hydraulic systems. The principle field will be electronics.

The second set of people needed will be those servicing the software. There will always be minor changes in the software and product changes which require updating the software. Software will be the largest area of concern in the factory of the future. Other positions will be available in the product design group where engineers at computer design stations will develop and refine the product.

What kind of industry commitment do you think there is to improving factory automation in the United States?

Most companies are now aware that the Japanese have been able to cap-



Computer-driven manufacturing in the Factory of the Future allows total shop floor control from a distance.

ture a good portion of the American market through automated production systems. Industry and government realize the need to improve American productivity. They further understand that true productivity improvement comes through factory automation. The problem is that we have become rusty in performing the task of automation. We have put an inadequate number of graduate engineers in the manufacturing programs in the factory. We have relegated that role of process engineer to people with inadequate education. *The greatest resistance to automating the factory is from the process engineer who is unable to understand the new technology.*

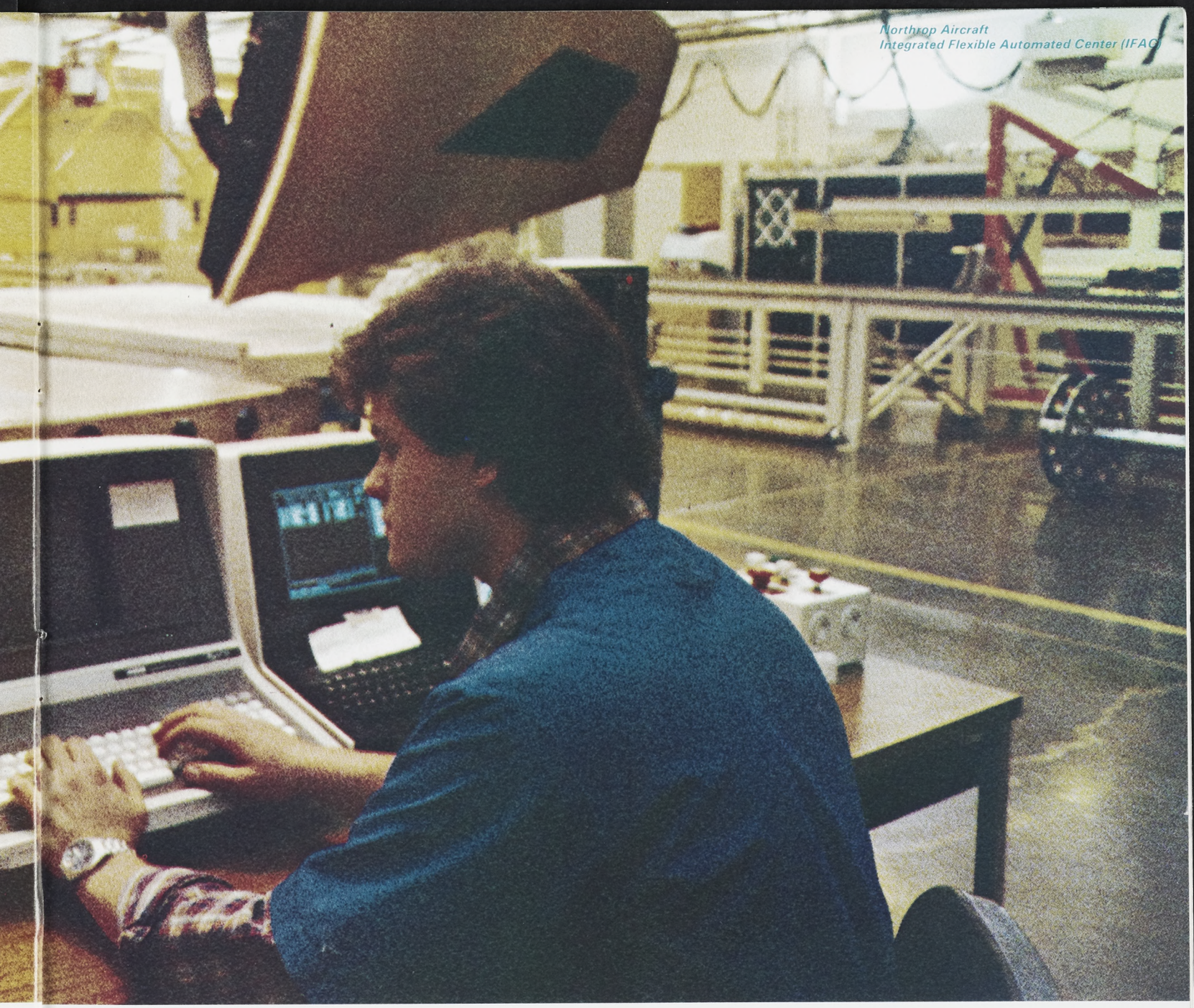
A solution to the problem is to educate the process engineer because we do not have enough new engineers to put in all those positions. We must recycle today's process engineer and teach enough about automation so he can apply it to his work load. It is one way to cure the fear of automation.

What kind of learning centers or research centers are there for studying the change in industrial automation?

Two years ago there was virtually nothing. Now, with the tremendous unemployment in the midwest there has been a turn around. All two-year state supported schools in Indiana have a plan in process to offer factory automation courses. Virtually all the private schools are offering vocational technology to help students become technicians in factory automation. This is also true in Michigan, New York, and Pennsylvania.

People talk a lot about countries like Japan and France being ahead of the United States in industrial automation and technology. Could you comment on this?

Virtually all the technology for the automation of a factory originated in the United States. What is different is the acceptance of the customer, his willingness to use this technology in his maufacturing system. This is mainly due to the education level of



Northrop Aircraft
Integrated Flexible Automated Center (IFAC)

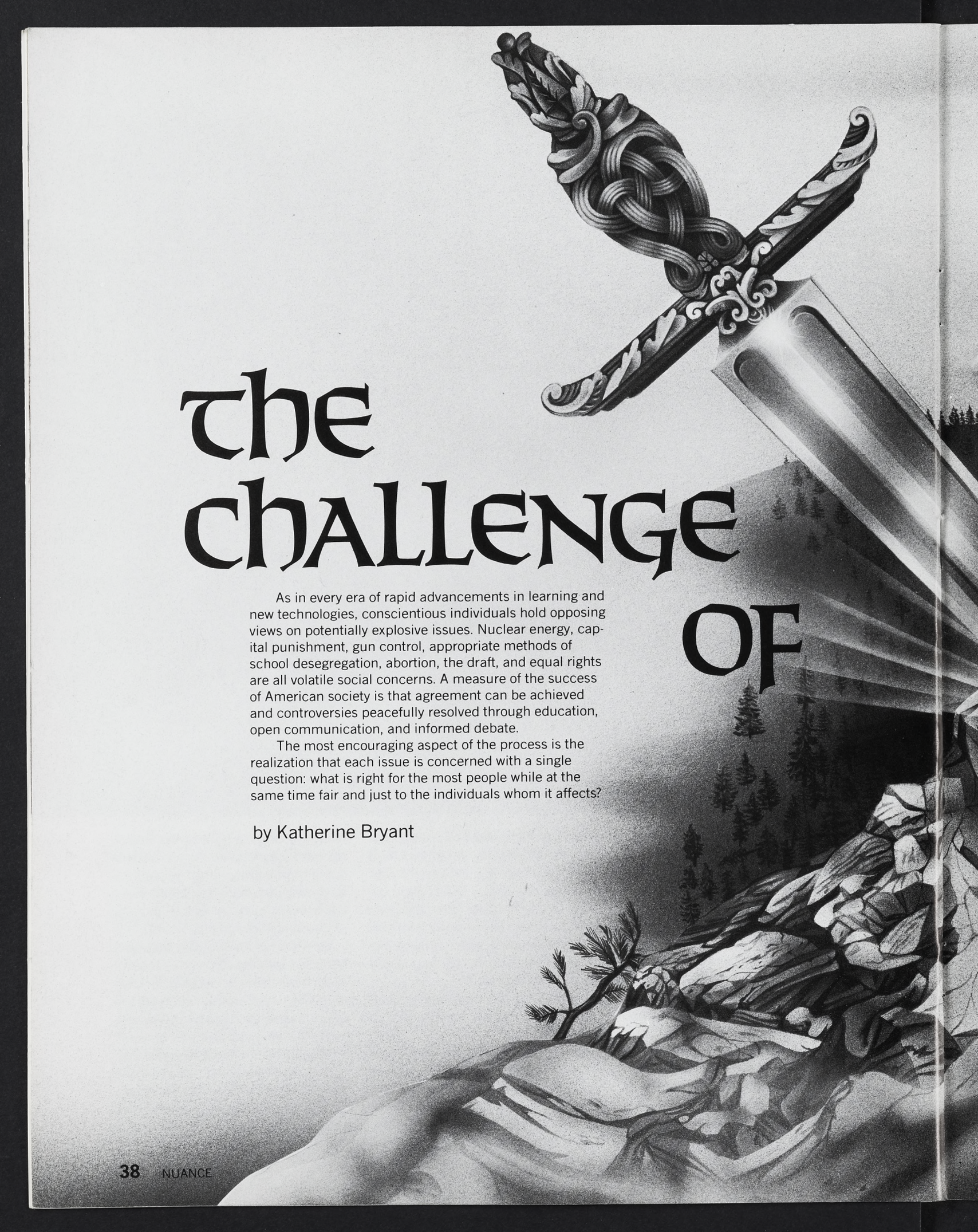
the process or manufacturing engineer. In other countries, the manufacturing engineer is held in high esteem equal to any other engineer. He is a very skilled person willing to try new things and eager to know the latest technology of manufacturing his product. In the United States there tends to be a discrimination against those engineers that went into the manufacturing department. This has resulted in many good people leaving manufacturing and going into product design, or other areas. The end result is a basically underskilled process engineering department in most industries.

New research studies indicate that when you get the young engineers excited about robots, and the application and manufacturing of robots, it helps to change the image of manufacturing and attract the bright engineers into that career. The stigma on manufacturing engineers is what has caused the United States to lag behind the European and the Japanese in new systems of production.

How would you characterize the state of the robot industry in the United States?

It is in the typical early development stage of an industry. Many people have been aware of robots for the last 20 to 30 years, but that has not allowed them to leave the development stage. Only the low cost of the microprocessor is making the field of robotics grow. However, we are still going through the violent cycles of a beginning industry when people react to rumors by redesigning their product or changing their supplier.

Very few of the robots installed today are working efficiently. Most of them have been misapplied or over sold. We are just now reaching the stage where we understand how to apply the products and how to install systems which show a fast payback. The real growth in robotics will be in 1988 and 1989 when we have mastered the applications of systems to manufacturing needs.

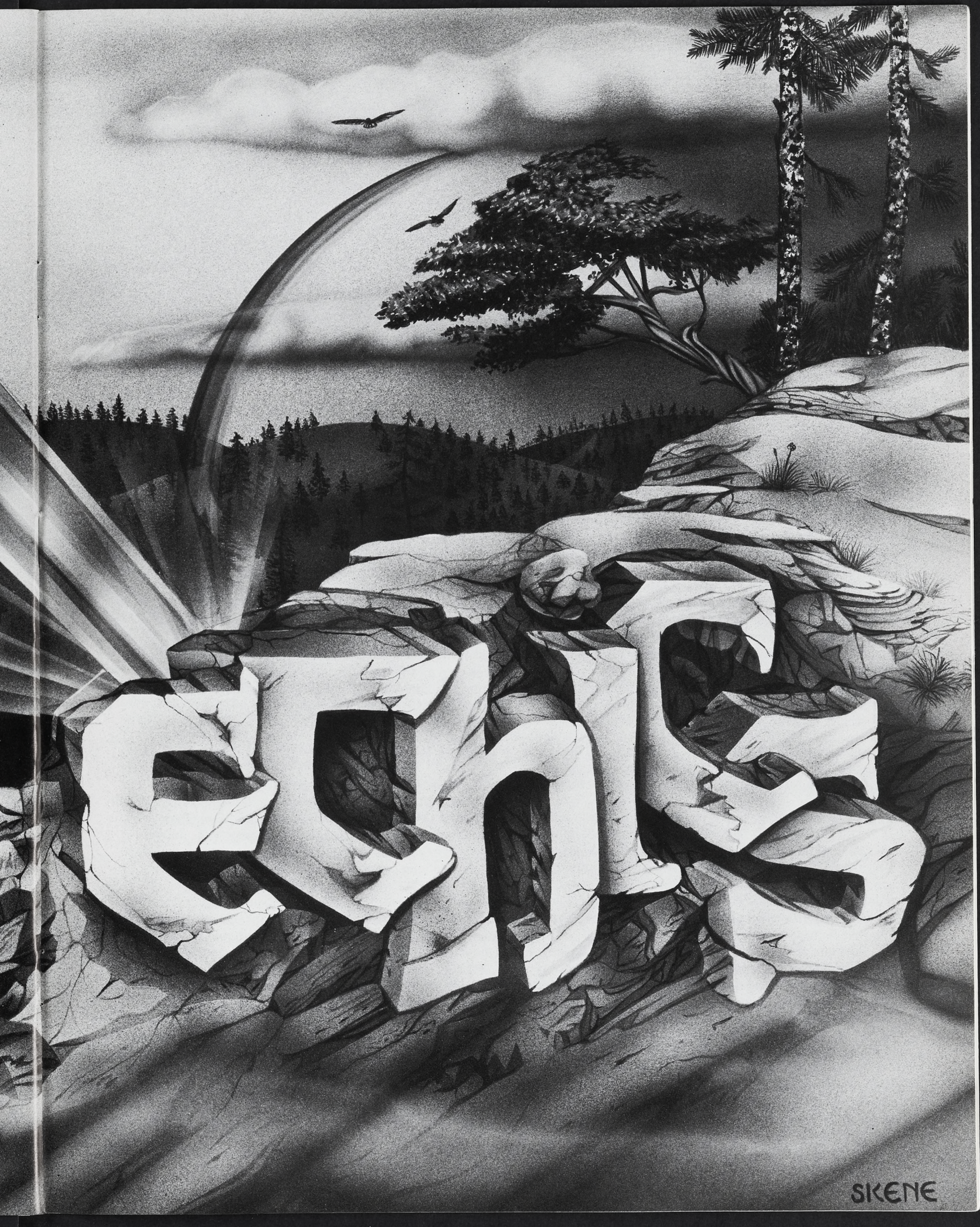


the challenge of

As in every era of rapid advancements in learning and new technologies, conscientious individuals hold opposing views on potentially explosive issues. Nuclear energy, capital punishment, gun control, appropriate methods of school desegregation, abortion, the draft, and equal rights are all volatile social concerns. A measure of the success of American society is that agreement can be achieved and controversies peacefully resolved through education, open communication, and informed debate.

The most encouraging aspect of the process is the realization that each issue is concerned with a single question: what is right for the most people while at the same time fair and just to the individuals whom it affects?

by Katherine Bryant


SKENE

The challenge of ethics is to resolve questions of individual rights within the larger context of society's needs. Finding that acknowledged standard of good or right behavior among individuals, businesses, and nations is preliminary to a basic respect for agreements, an equitable exchange of goods, and valid promises. A society without an acknowledged standard of ethical behavior lacks credibility in the eyes of its peers.

The importance of ethical decisions in business was recently underlined in a FORTUNE survey. Top corporations were evaluated on eight key attributes of reputation, among which were two strong ethical points: ability to attract, develop, and keep talented people, and the company's measure of community and environmental responsibility. Hewlett-Packard came in first for its ability to attract and keep talented people. Eastman Kodak placed first in company responsibility to the community and environment. IBM followed second in both categories, but placed first in over-all corporate reputation. In all cases, the decisions made by corporate management determined the company's public image.

Ethics in Education

Whether education accepts the challenge to introduce ethics into its business curricula is more than an academic point. According to top-ranking corporate management and the FORTUNE survey, the public considers a sensitivity to ethical considerations as a criterion of corporate success.

Business and ethics are old acquaintances. Basic to most civilizations and older than law itself is a code of business ethics. Among the oldest beliefs are those valuing human life, honesty, and fair dealing. *Caveat emptor* (let the buyer beware) notwithstanding, the buyer has been more or less protected in most societies from the beginning of recorded history.

However, with the increasing complexities of social group organizations and interests, steering an ethical course becomes more difficult. Definitions of honesty, fairness, loyalty, generosity, compassion, and respect are no longer clear. The press, the courts, and the classroom provide modern forums where society can examine the conflicts involved in today's complex ethical decisions without recourse to violence. Encouragement of open debate can help strengthen and define an individual and a society's sense of ethical responsibility.

Traditionally, ethics has been taught in philosophy departments. Higher education may find that business and management courses provide another appropriate forum for the discussion of ethics. A glance at daily headlines explains why. Companies are being sued for misleading advertisements. Banks are under fire for misapplying funds. Manufacturing industries are held responsible for the disposal of toxic wastes and for unsafe working conditions. The extent of these responsibilities is expanding. Much of the dilemma of management today hinges on ethical choices in corporate policy.

Conflict of Interest

The manager of a corporation faces often-conflicting demands from various entities which lay rightful claim to his loyalties. The board of directors and the shareholders demand that the enterprise operate profitably. The employees expect fair and competitive compensation, favorable working conditions, and opportunity for advancement. The manager is also responsible to his customers for a competitively priced quality product whose values are honestly presented. Public demands are made on management for protection against pollution or reckless waste of natural resources.

Conflict of interest is a consideration which further complicates the conduct of business, government, the professions, higher education, and the legal system. Resolution of the conflict involves putting duty above selfish interests in reaching unbiased decisions. A judge for example, who holds securities of an enterprise under litigation knows that rather than sitting in judgment on the conduct of the enterprise he should disqualify himself as having financial interest in the outcome of the litigation. The use of privileged information for personal gain is

The importance of ethical decisions in business was recently underlined in a FORTUNE survey. Top corporations were evaluated on eight key attributes of reputation, among which were two strong ethical points: ability to attract, develop, and keep talented people, and the company's measure of community and environmental responsibility.

involved if an employee of either of two companies which are privately discussing merger buys or sells securities hoping to anticipate a rise or fall in prices. Whoever misuses his privileged position for personal gain has attempted to profit at the expense of the uninformed.

Employment Concerns

The right to work is a value inherent to democratic systems and defended and protected by many interest groups. Fair employment regulations are a vital part of any managerial understanding. Failure to act honorably in this ethical arena can impair the company's public image.

Employment and recruitment policy reflect a company's sense of responsibility toward the individual employee. Management faces a sizeable moral dilemma when deciding whether to retain an intelligent, productive employee or choose a replacement who is even more capable. Considerations of loyalty, employee morale, customer relations, and the incumbent's familiarity with the work of the institution may all lead the manager to opt for keeping the employee he has. It may be a comfortable and popular decision. It would be difficult, however, if not impossible, for a manager of a professional athletic team to reason in the same way when recruiting players for a top performance.

In a time of recession, additional problems arise when companies must consider necessary layoffs and terminations. Custom often dictates that seniority be respected as the prime consideration in retaining employees. Since affirmative action is only a fairly recent development, the group most affected by layoffs of the last employed would therefore be minorities and women.

The work of management is further complicated by changing rules and wildly increased demands for compensation on the part of employees, consumers, and juries.

Today's corporation is expected to meet demands that it operate so as to provide not only a profit to its owners but good wages, safe working conditions, advancement for employees, and protection for customers and the public. It is also expected, under the principle of utility, to provide the best possible benefits to the largest numbers of society's members, plus meeting the demands of individuals for the moral rights and justice to which they are personally entitled under the laws and the Constitution. The requirements for utility on the one hand and moral rights to individuals on the other are sometimes in conflict and must be mediated, or the one sacrificed to the other. Where human elements are involved, benefits generally go first in the direction of moral right and justice to the individual.

Affirmative Action

It is clear that the society which encourages all its members to prepare and to perform at their highest levels will be more productive than one which keeps large numbers submerged through lack of opportunity. In considering the interests of society and the individual, we must somehow face and answer the questions of those who without the benefits of affirmative action would fail to qualify.

Other employment questions still need resolution. The question of the right of employees in the public sector to bargain effectively for improved hours, wages, and working conditions is constantly debated, even at the polls. On the one hand is the contention that public employees perform vital services to society and should not be permitted to discontinue functions which cannot readily be provided by other means, obvious examples being education, bus service, fire and police protection, and refuse disposal. Yet on the other hand the right of workers to organize and to demand redress for grievances is believed to be inherent in our constitutional life.

To many, it does not seem fair that public employees alone be denied the privileges for which workers have won such hard-fought battles. They reason that if employees in the public sector are not to be allowed the ultimate right to strike when such other efforts as mediation, fact finding, and arbitration fail, there is little real value in their right to organize.

Responsibilities to Employees

Since the most costly commodity which most businesses buy today is the time and effort of their workers, a top managerial priority is to find effective ways to merit their loyalty and best output. Without respect for the concern which pays them, workers can act or fail to act in many unfavorable ways. Taking advantage of sick leave, time-consuming, costly use of the telephone, theft of company office supplies, postage, and tools, extended coffee breaks and lunch hours, and the habit of winding down before quitting time are all evidences of a lack of employee involvement with the well-being of the organization. Poor work habits will not all be eliminated by a concerned management policy, but they can be minimized through providing employee incentives and rewards.

Advancement is, of course, the magic word in building employee morale, and it goes hand in hand with advancement opportunity. The corporation which honors a policy of promotion from within the organization has two strong advantages. Nothing is better for employee morale than the knowledge that the company will look first at its own personnel when seeking talent to fill management positions. Conversely, nothing is more stultifying than the "what's the use?" attitude which follows the selection of outside talent to fill a position which could have been filled from within.

This is not to say that there are not advantages to instilling new blood into a work force which has perhaps been allowed to stagnate, but a consideration of the talent already on board has much to recommend it.

Managerial concern for employees is also measured in company respect for employees' suggestions and ideas. A conscientious worker who is encouraged to turn his thoughts to the concerns of the company may well come up with creative solutions. This potential human resource in a company's work force should not be undervalued.

Another attitude on the part of the company which builds employee participation is to offer workers an opportunity to express a preference when a decision is to be made which will affect their work or well being. It is productive, for example, to ask the members of the work force whether they would prefer working late for three nights to working on a Saturday. They won't all agree, but they will have been asked.

New Technologies and Public Safety

Perhaps as interesting as any of the ethical issues facing business, government, and the public today are those brought about by advances in technology, public awareness, and the extended application of First Amendment rights. Through the use of modern research technologies, some of the components of industrial materials have proven to be dangerous to life and health. The issues raised by the Love Canal and the asbestos controversies have become so familiar and yet so puzzling that they almost defy resolution. What started the problems did not happen recently. The difficulties arose from former methods and materials in use, by earlier management. They may have been ignorant about the danger or about the extent of danger inherent in either material or process. The extent of their accountability is difficult, at best, to assess.

There was a time when various types of danger were considered to be among the hazards of having a job. The men who carried the strands of cable across San Francisco Bay during the building of the Golden Gate Bridge worked for a time without safety nets, yet there was no shortage of applicants for the work. On the fiftieth anniversary of the beginning of the project, men who had worked on it recalled that when a worker fell to his death, everyone working on the cable got the day off. Rodeo hands and professional football players, not to mention professional boxers, live with pain and know that at any time they may suffer injury. It was accepted that coal miners didn't live as long as workers in other industries.

Fairness dictates that if one set of industrial victims is entitled to compensation, then others suffering industry-related difficulties must be equally eligible to proportional compensation. There remain a number of questions. By whom shall the victims be compensated? On what basis? How shall the extent of the damages be determined? Shall each come under an established system of compensation, or will court action be necessary in each case? If so, who bears the cost of court action?

Gradually a recognition of occupational hazards came about, and a sense of responsibility for them grew.

The dangers of black lung disease to coal miners were known and to an extent dealt with before it was discovered that workers in textile mills were also suffering from work-related illnesses. Fairness dictates that if one set of industrial victims is entitled to compensation, then others suffering industry-related difficulties must be equally eligible to proportional compensation. There remain a number of questions. By whom shall the victims be compensated? On what basis? How shall the extent of the damages be determined? Shall each come under an established system of compensation, or will court action be necessary in each case? If so, who bears the cost of court action? Questions arise as to the advantages and effectiveness of industry self-regulation over government regulation.

The entire scope of possible industrial responsibility has yet to be determined. Perhaps more important even than treatment and compensation is the prevention of future damage. The question of whether punitive damages are appropriate in the case of industries which were acting in good faith according to then-current standard needs to be considered. That harm was done can be fairly clear, but at what point can one determine and assess the damages to health and safety of future generations?

It is not certain that individual indemnities running into vast sums are the answer. According to news reports, Johns-Mansville, a firm using asbestos in the manufacture of fire-proof materials, although now operating at a profit, has announced that there is no way for them to anticipate paying all potential litigants the amounts of compensatory damages likely to be awarded. They have therefore stated their intention to go out of business. Should this occur, their bankruptcy may result in an equitable distribution of their assets. It does not, however, answer society's need for alternate, fire-proof industrial materials.

Rights Infringement

Not all ethical questions involve life and death or damage to health and life expectancy. Widespread today, because of low cost and easy access, is the habit of duplicating and freely distributing copyrighted material. In most cases, this is neither more nor less than a sophisticated form of theft. It is not uncommon in an educational institution to see an instructor running off multiple copies of individual pages, a magazine article, or a chapter from a book for use in class. Libraries and agencies of the government have repeatedly published guidelines as to what may and may not be copied and in what numbers, yet the simple fact that the material is convenient to the instrument for reproducing it makes the unethical and illegal act easy and seemingly harmless. Yet copyrighted material has potential monetary value to the author, a value diminished by its unauthorized reproduction. Virtually the same is true of material broadcast over radio and television which may be electronically perpetuated through the use of equipment now available in homes and automobiles. Among the reasons for these widespread abuses of property rights is simply that, like Mt. Everest, they are there for the asking, and unlike Mt. Everest, at low cost. With more sophisticated duplicating equipment becoming more available and less costly, it is unlikely that the tide of larceny can be stemmed by legal methods alone.

Like the cure for many of the serious problems of society, effective correction may in the long run depend on education, an increased emphasis on respect for ethical considerations, the rights of others, and informed discussion of the problem. nu

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Katherine Bryant teaches Business Ethics and Business Communication in the College of Business and Management, Northrop University.

THE UNIVERSITY'S SHARE OF DEFENSE

BILLY J. SHELL

President of Northrop University
and the California Engineering Foundation.

The power to deter an attack and escape unharmed is not the same as the power to provide for the common defense. Military strength alone cannot carry the weight of national security, not when we are at war economically. Even emergency funding and crisis programs will not recover economic security. The deteriorating industrial base and weakened education system are beyond patchwork repairs. Without a strong national commitment to maximize our human resources and strengthen our technological base, the United States will not have the leadership or the productivity to compete in future world arenas. National security ultimately depends on our success in a fiercely competitive world market.

As a nation, we need to examine our capacity for economic as well as military defense. National commitment to a technology-intensive military without a corresponding commitment to education and research is frontline defense without a back-up strategy. Currently, especially in the primary and secondary levels of American education, there is little strategic preparation for careers in science or technology. The information explosion, for the most part, stops at the entry level to education. In an age of communication technology, the capacity to exchange and share information is actually diminishing within the education system and the United States has no education objectives to counter this erosion of its learning base.

Sporadic funding for isolated crisis programs is not enough. The academic world, private industry, business, and government must find a new systems approach to achieving mutual goals. **We need stronger national incentives to stimulate increased multi-sector cooperation.** The large scale integration of technology, in pure and applied fields, depends on an interdisciplinary, multi-sector planning. It requires a broad, flexible knowledge base in the social, biological, and physical sciences, as well as the engineering fields, to assure optimum human-machine interaction and acceptance.

Cooperative development of technology is a safeguard of the pluralistic system. The free exchange and collaboration among interest groups for a mutual purpose is part of the vitality of a free-enterprise system. Cooperative projects minimize redundant research, pool manpower, stimulate commercial spin-offs, and increase the competitive edge of industry internationally. Shared development of a human-scale technology also helps counter the fear that technology threatens the fabric of society or the humanity of any part.

Since the 1950's and the founding of the National Science Foundation, the Federal government has acknowledged its responsibility to support basic research. It has

encouraged cooperative research projects and innovative linkage systems between industry and universities. Both the National Bureau of Standards and the National Science Foundation have worked to increase the non-federal support of research and development as well as to improve the applications of the results. Collaborative research projects are increasing between specific industries and universities. However, today's minimum base of knoweldge for the development of a new technology begins at the doctoral level. **We need stronger incentives for postgraduate studies and for extended university-industry collaboration, not only between individual industries and universities, but among groups of industries and universities as research associations.** Ultimately, this scale collaboration requires the encouragement of national priorities and incentives.

Today's large research support is federally funded. Corporate support of research comes from only a limited number of high technology industries to a very limited number of universities. Not more than 100 universities nation-wide receive substantial industry support. Considering that 40 percent of higher education institutions in the United States depend on tuition revenue to survive, the corporate contribution to education still remains underdeveloped. Federal and state government will continue to bear the cost of research support until a vital, productive association of education and private industry is stimulated beyond the level of a one-to-one cooperation.

The education system in the United States can provide a strong base for the large scale development of the sciences and technology, but to be successful, it requires the active voice of government to stimulate new linkages between industry, business and education. As a nation, the United States has never been forced to maximize its brain power in order to hold a position of world leadership. We have been a "natural" leader among nations because we are rich in natural resources and our economic system encourages individual achievement. Government has served to check and balance interests, rather than push or dictate directions. The free-enterprise market provides the incentives to development. Other countries do not have these advantages. Consequently, their governments dedicate entire social and economic structures to achieving national goals. In dedicated structures like the Japanese and Russian, government pushes the achievers to accomplish national priorities. These systems begin looking early for the gifted. They have strong national objectives for world leadership in the sciences and technology. It will be interesting to see if their model of education can develop a keener intellectual capacity to compete internationally.

Restricting the flow of information between the United States and other nations will not guarantee a technological edge in competition. The federal government has more effective means to shift the internationl balance of competence. When I was in college, only 5% of the collegiate-age youth of the United States thought of college as an opportunity. After World War II, largely through the G.I. Bill, higher education exploded from centers of 5,000 students to metropolitan conglomerations of 45,000 students. Education is going through a similar transition today. Competitive industrial pressures to develop new materials, new manufacturing processes, and new technologies are spurring corporate investments in education and research. The Reagan Administration encourages this exchange between industry and university through a program of tax incentives. The Economic Recovery Tax Act of 1981 provides a 25% tax credit for incremental increases in industry R&D expenses. It also allows an increase in charitable deductions to cost plus one-half the difference between the cost and fair-market value for donation of new equipment (less than two years old) by an equipment manufacturer to an institution of higher learning. This is a step toward change, but it is not sufficient encouragement for industry cooperation to equalize the knowledge gap between advanced industry R&D and college curricula. **The federal government needs to recognize that higher education cannot provide today's industry with appropriately trained employees when there is a four-generation information gap between education and industry. We need clear national incentives to encourage information sharing.**

An important decision is about to be made concerning the future role of higher education. It is not clear what kind of university will emerge. Already, many corporations have developed their own in-house education programs to assure a quality level of employee performance. Specific job-training approaches to education, may eliminate the breadth requirements for a social, cultural and personal enrichment of the student's academic experience. We need to assure that the education system will continue to prepare students, not only for employment, but for a more successful life. Now, more than ever, we need to assure that the education systems provide a broad base of knowledge for each specialized field. As advanced technology demands an increasingly flexible, interdisciplinary approach, we need to prioritize a commitment to education as a cooperative, shared venture. The benefits to industry, education and international competitiveness are reciprocal. Integrating the benefits of technology will go a long way toward building a secure base of human resources.

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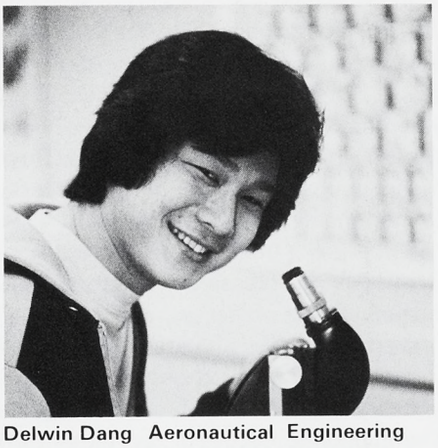

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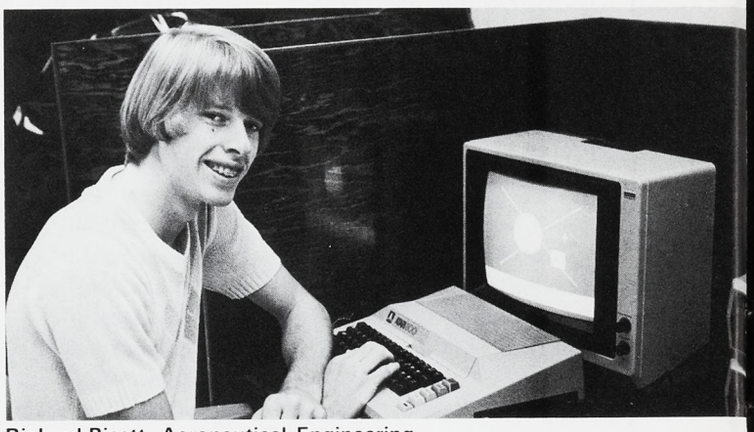

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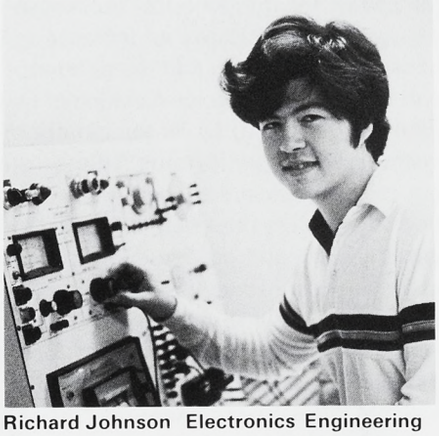

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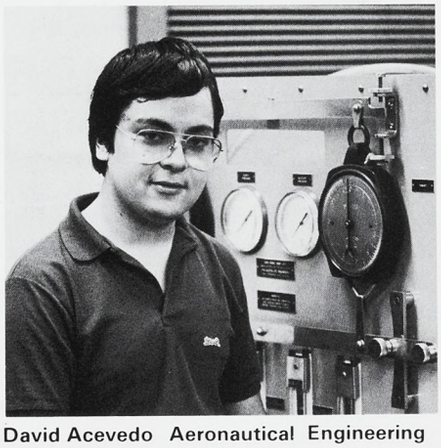

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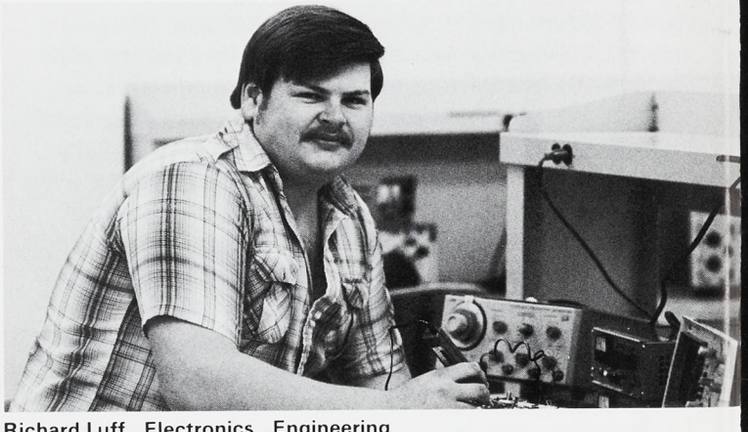

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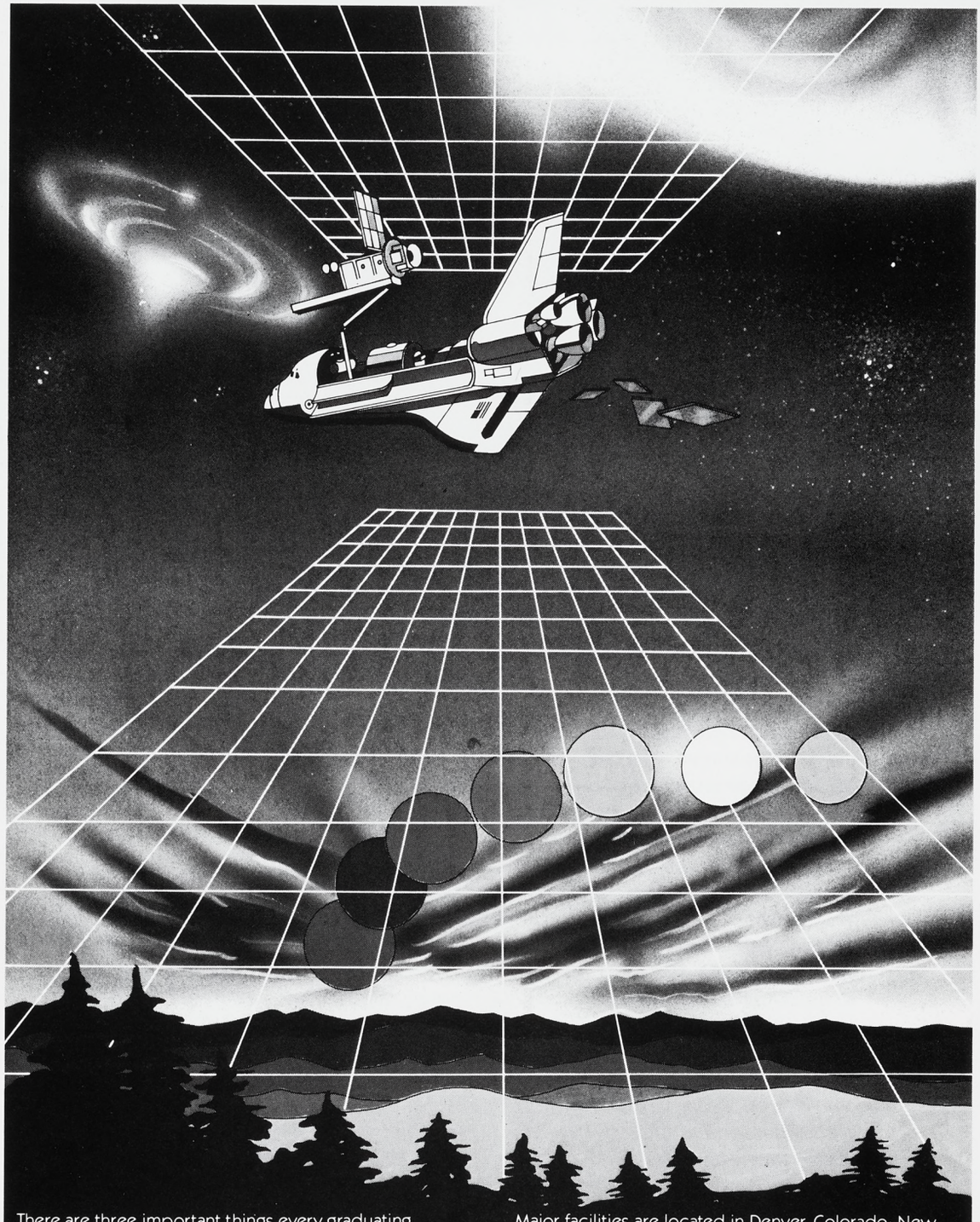

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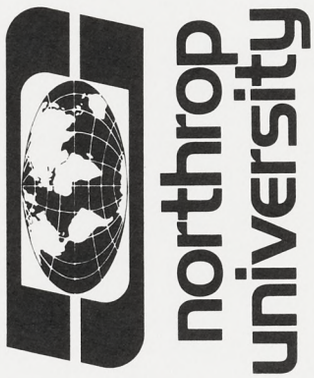

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